

# Current status and development of plant pest information management system in Taiwan

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## Introduction

Located in the subtropical zone, Taiwan is known for its high-temperature climate, humidity and complex terrains. The farming land ranges from tropical rainforest climate to temperate zone at high altitudes. Complicated by intensive multiple cropping, Taiwan has long been threatened by plant diseases and pests which are important limiting factors to the agricultural production. With the liberalization of agricultural trade and the accession of Taiwan to the World Trade Organization (WTO), the imports of agricultural products to Taiwan have been increasing greatly, resulting in the high risk of invasion by exotic plant diseases and pests. Thus, problems and damages caused by the diseases and pests have been becoming more important in recent years. Various measures have been taken to ensure a safe agricultural environment in Taiwan and to promote plant health. The measures include strengthening of import quarantine and inspection, development of detection and diagnosis technology, establishment of a nationwide plant pest monitoring and reporting system, development and promotion of effective prevention and control methods, collaborated control of important plant diseases and pests, and strengthening of farmer and public education, etc.

In the past three decades, several invasive plant pests had been found, such as *Pomacea canaliculata*, *Bursaphelenchus xylophilus* and *papava ringspot virus*. They have severely affected the ecological environment of Taiwan and increased the cost of agricultural production dramatically. Through past experiences, it is shown that the occurrence of plant diseases and pests could often be traced and effectively contained of their spread if monitor of their situations and resulting damages could be carried out with concurrent employment of preventive measures in a timely manner.

## **Development of plant pests surveillance in Taiwan**

The efforts of Taiwan in plant pests monitoring began in the 1960s when the “early alert of rice diseases and pests” program was implemented. To protect the production of rice, the most important food source in Taiwan, the former Joint Commission on Rural Reconstruction (JCRR, currently the Council of Agriculture) coordinated with the district agricultural improvement stations (DAISs) of the Taiwan Provincial Government. Together, they conducted rice disease and pest monitoring and occurrence prediction work on all rice production areas in Taiwan. In 1974, the banana export of Taiwan reached a record high in history, with 8 million cartons of bananas exported from Taiwan to Japan. A banana disease and pest early warning system, which was under the supervision of Taiwan Banana Research Institute, was then established for monitoring the diseases and pests of banana in the Kaohsiung and Pingtung areas. In 1994, in order to reinforce the prevention and control of Oriental fruit flies, Melon fly, Common cutworm and Beet armyworm, Taiwan Agricultural Research Institute (TARI) and Taiwan Agricultural Chemicals and Toxic Substances Research Institute (TACTRI) cooperated to set up a monitoring program for pest density and distributed the population density newsletter of those pests to extension workers and farmers. Ninety-six monitoring sites were established around Taiwan, systematically surveying their occurrence and conducting data analysis to provide related information of the pests to farmers promptly.

Starting from 1990, in order to provide support and services of crop disease and pest diagnosis and to promote management technology to farmers, the Council of Agriculture (COA) has subsidized TARI, TACTRI, DAISs and related universities to establish crop pest diagnosis service stations. Currently 30 stations are under operation. Through the provision of pest diagnostic services to farmers, the COA was able to collect information on various crop diseases and pests. For the first time in Taiwan’s agricultural history, scope of monitoring was greatly expanded to cover most crops and their diseases and pests in the system. In 1997, under the supervision of the former Department of Agriculture and Forestry of Taiwan Provincial Government, TARI, TACRI, and DAISs, then still governed by the former Taiwan Provincial Government, established a plant pests monitoring system (the forerunner of present plant pests monitoring system). The system comprehensively integrated monitoring survey, investigation, identification and reporting of plant diseases and pests in Taiwan. With the assistance of computer networks, the plant pests monitoring work of Taiwan was modernized and computerized.

On August 1, 1998, the Bureau of Animal and Plant Health Inspection and

Quarantine (BAPHIQ) was established with the responsibility of the planning and administering nation-wide plant health and pests management. In 1999, the BAPHIQ established the current “plant pest monitoring system” in that active monitoring of plant pest is conducted, and pest investigation, notification, warning are carried out, relevant data are recorded and analyzed, and diagnosis services is provided. In addition, the BAPHIQ further established the “Taiwan agricultural pest database” and “plant pest geographical information system” in 2003. These two systems offer pest control officers with information of the diseases and pests to facilitate their management . In order for improving the systems, the “plant pest management network” based on the current “plant pest monitoring system” and the “plant pest geographical information system” was constructed in 2005. The network will fulfill the needs for analyzing integrated plant pest information and establishing geographical information system.

## **Current status of plant pest management network**

### **1. Introduction of the system**

To understand the dynamics and ecology of the diseases and pests will facilitate strategic planning of pest management. Periodic monitoring can assist in the prediction of occurrence of plant diseases and pests, hence making it highly possible to effectively contain the spread of the diseases and pests, with eco-friendly measures at the appropriate time. In order to facilitate the collection and analysis of important plant diseases and pests for further understanding of their status in Taiwan, BAPHIQ has established a nation-wide plant pest management systems and made further improvement. The system has greatly enhanced the capability of the plant protection authorities in decision-making for timely implementation of integrated pest management (IPM) strategies.

### **2. Structure of the system and scope of work**

The plant pests management system is composed of 6 different functional units including a control center, 8 regional pest monitoring centers, an information center, 5 identification centers, 30 crop pest diagnosis service stations and 25 local government pest information centers. The scope of their works is described briefly as follow,

#### **(1) Control Center**

The BAPHIQ serves as the control center, and is responsible for and managing the nation-wide plant pest monitoring system, organizing and coordinating surveys,

investigations, evaluations, and joint examinations with other institution of dangerous plant pests, forming management strategies and carrying out press releases.

## **(2) Regional pests monitoring center**

The Center is located each at 7 DAISs and Taiwan tea experiment station currently all under the COA. They are responsible for evaluation, investigation and joint examination of the diseases and pests, collection and compilation of related information, and planning of active control strategies within the regions. They also need to report important diseases or pests which are either region-wide or nation-wide and are under monitoring.

## **(3) Information Center**

TACTRI serves as the information center. The center is responsible for analysis, compilation, filing, and storage of information collected through diseases and pests monitoring, and maintenance of computer operating systems.

## **(4) Identification Centers**

The BAPHIQ commissions 5 agencies, namely the National Taiwan University, National Chung Hsing University, National Chia Yi University, National Pingtung University of Science and Technology, and TARI, respectively to serve as disease and pest identification center and to maintain the specimens.

## **(5) Crop pest diagnosis service stations**

Thirty crop pest diagnosis service stations have been set up each at TARI, TACTRI, DAISs, related universities and private organizations, respectively, to provide farmers in proximity with the diseases and pest diagnosis and consultation services either call in or on site. The station is also responsible for compiling and reporting the diagnostic cases for the purpose of understanding crop pest status at different places. In addition, they also assist in the follow-up investigation and joint diagnosis of dangerous diseases and pests, forming active control strategies and implementing pest control measures.

## **(6) Local government pest information centers**

Taipei and Kaohsiung municipalities and all other county and city governments have established plant pest information centers to deliver pest notifications or pest alerts announced from the system, and provide information related to plant pest management is provide to local farmers. In an emergency of pest outbreak, they are able to coordinate and communicate with local farmers and farmers' groups to

cooperate with the competent authorities in implementing relevant measures and tasks of emergency or coordinated control.

## Methods of information gathering

How the plant pests monitoring and reporting system collects pest information is shown in Fig.1. The methods can be divided into two categories:

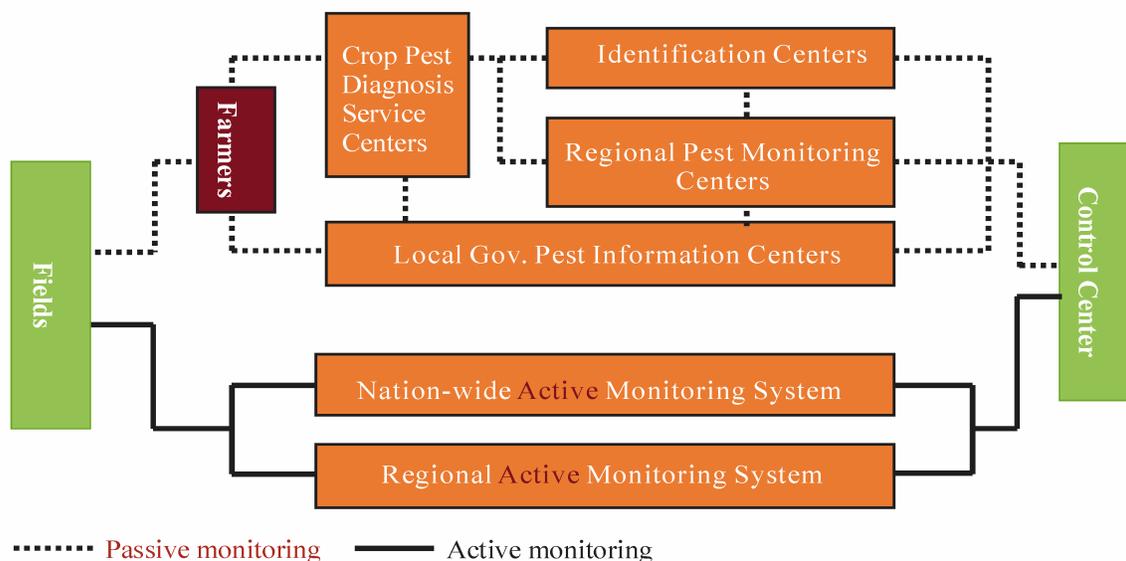


Fig. 1. The structure of functional unit and the way of gathering information

### 1. Active monitoring

Population dynamic of major plant pests is monitored periodically on national or regional scale by specialists from aforementioned agricultural institutes, and collected and analyzed by plant protection authorities. Early alerts and recommendation of control measures are released to farmers through the Internet, newsletters and/or telephone. Currently, three systems are operated in the active mode for monitoring the pest status:

#### (1) Nation-wide active monitoring system

TARI and TACTRI work together to form the active monitoring system and issue pest status newsletters of Oriental fruit fly (*Bactrocera dorsalis* (Hendel)) and other major crop pests such as melon fly (*Bactrocera cucurbitae* (Coquillett)), tobacco cutworm (*Spodoptera litura* (Fabricius)) and beet army worm (*Spodoptera exigua* Hubner). TARI is responsible for data collection, editing and delivering the population density newsletter every 10 days. TACTRI is responsible for data analysis and forecasting. By providing the density and forecasting information to farmers, the

system has gained a great accomplishment in reducing the cost of pest control and the damage caused by the pests.

### **(2) Regional active monitoring system**

In order to protect some major crops from the damage of pests in certain regions, the regional pests monitoring centers actively carry out periodic monitoring surveys and predict the development of pest based on the data.

### **(3) Nation-wide quarantine insect pest survey**

For prevention of possible invasion of plant quarantine pests, BAPHIQ in collaboration with National Taiwan University and TARI organized a team for detection survey of exotic insect pests. With the assistance of 7 DAISs and 6 universities, the team has set up a detection network with 1,015 trapping sites in Taiwan. The members of the team are all responsible for data collection and reporting. The university and TARI are also responsible for allocation of trapping site, purchase of trapping material and confirmatory identification of the collected specimens.

## **2. Passive monitoring**

Actual status of pests in the fields is observed through the specimens collected from the farmers and diagnosed by the thirty crop pest diagnosis service stations.

In the event of the severe occurrence of major pests or invasion of quarantine pests, the control center will immediately form a task team consisting of scholars and experts in related fields and plant protection staff at local governments to tackle the problem. If a quarantine pest is found, emergency actions will be taken promptly.

## **Future prospects**

In the future, the “Plant Pest Management Network” will be further enhanced by employing rapid-warning messaging system, pest inquiry database and geological information system. The works of disease and pest monitoring will be carried out in more efficient way by integrating various agricultural research institutions, local governments, private organizations and farmers’ groups, more closely so that the future goals of more comprehensive monitoring, immediate reporting, accurate diagnosis and efficient management can be achieved. By working together, a comprehensive plant pest management network will be provided to farmers and plant protection extension workers with efficient, accurate and professional services to safeguard the agricultural environments in Taiwan.