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Popular Article

THE CROP DISEASE AND PEST WARNING AND FORECASTING SYSTEM

Rupali Shrivasini Parida, Prittam Das and Satya Narayan SatapathyInstitute of Agricultural Sciences (IAS), Siksha 'O' Anusandhan, Campus-4,
Bhubaneswar, Odisha-751029 Open Access

Introduction

The crop diseases and insect pests were all important biological hazard in agricultural production, and for many years, they restricted seriously the agricultural sustainable development. Statistics from the UN Food and Agriculture Organization showed the world grain yield lost 10% because of pests and 14% because of diseases for many years. At the same time, the world cotton yield lost 16% because of pests and 14% because of diseases. It was more than important to predict the occurrence and development of diseases and insect pests by different forecasting methods. According to forecasting result, decision makers and users could make correct prevention standards and proper treatment measures in order to obtain the maximum economic benefits on the condition of minimum capital investment. A warning system of diseases and pests which was established based on GIS (geographic information system) and RS (remote sense). And the establishment of the system involved lots of objects, including agronomy, soil science and meteorology, and so on. Besides using the kinds of functions with GIS, the remote sense was also developed in

the warning system to obtain fast and real-time the information of diseases and insects, which improved the accuracy of early warning result to a certain extent.

THE ESTABLISHMENT OF THE WARNING SYSTEM

A. The basic goals of the warning system

The basic goals of the warning system were as follows:

- ✓ By using the warning system, data information could be transformed into a geographical information map to show the occurrence and distribution on variety of diseases and pests by using visualization and spatial analysis with GIS.
- ✓ The warning system could obtain fast and real-time the information of diseases and insects by using RS, and finally it could accurately monitor the occurrence and predict the development of the diseases and pests in large area.
- ✓ Some standards and measures could be made for the investigation and



controlling diseases and pests according to the pre-warning results of the warning system.

B. The design and realization the warning system of crops diseases and pests

➤ **Design route**

At first, it was important to choose feasible GIS platform and the forecasting model on diseases and pests after requirement analysis. Second, database was established according to parameter of model, and function modules of the system were also designed.

➤ **Platform selection**

Super Map IS. NET was chosen as the system development platform, the reasons were as follows:

- ✓ Components of design could be easily managed.
- ✓ The Multi-source data could be integrated and the massive image could be quickly accessed to.
- ✓ Server was clustering; it was with a high degree of flexibility.
- ✓ In the platform, Client and server belonged multi-level cache structure, which could support a variety of map engine work together.

➤ **Database design**

✓ **Attribute database**

- ✚ The attribute database of the system was composed with monitoring data, basic data on diseases and pests, national meteorological observation data and the data table about latitude

and longitude of meteorological observation site, and so on.

- ✚ Monitoring data on diseases and pests: field investigation data, monitoring data using remote sensing, field experiments data, and so on.

- ✚ Basic data on diseases and pests: diseases and pests species data, damage characteristics data, control and preventive methods data, and so on.

- ✚ National meteorological observation data: temperature, moisture, rainfall and sunshine number, and so on.

➤ **Spatial databases**

- ✚ The spatial database of the warning was composed of basic map, thematic map and warning information map.

Basic map: national administrative division map, digital elevation map.

- ✚ Thematic map was got by basic map according to some goal, which included weather map, remote sensing imagery and crop division map.

- ✚ Warning information map was obtained by spatial analysis on the basic of few thematic maps and analysis result of prediction model, by which the system could show the occurrence and distribution on variety of diseases and pests. And ultimately, some effective guidance can be given to prevent and control the diseases and pests according the warning information map.

➤ **Basic functions of the system**

The functions of warning system were composed of special functions and general functions which were offered by GIS platform, including the translating, mitigating and amplification graphics, and adding and deleting map layer, and so on. While the special functions were as follows:

✓ **Retrieval of diseases and insect pests**

Users could search all kinds of knowledge about diseases and pests, for example, latin name and English name of disease and pest, damage symptom and epidemiology on diseases and pests and control methods.

✓ **Diagnosis of diseases and pests**

Users could obtain some papers on warning results and forecasting methods after the operations of systems by various data and forecasting models of diseases and pests.

✓ **Model base management**

Administrators could add, delete, or modify the models in the system by Model base management.

✓ **Monitoring and evaluation using remote sensing**

By the function module, users could develop monitoring and assessment the diseases and pests and related remote sensing images could also call from spatial database and displayed for users.

✓ **Visualization of warning result**

By making visualization and spatial analysis with GIS, the system could transform prediction result and emergence grade into a geographical information map to display

visually the occurrence and distribution on variety of diseases and pests.

Warning flow

The warning system was established on the basic on a database which was composed of attribute database and spatial database and a model base including diseases models and pests prediction models. At first, the result which was obtained by prediction model form model base and data from database was displayed in the GIS platform and was transformed into information diagram; meanwhile, some thematic maps from spatial database were overlaid on the information map. Finally, the system could offer a clearly electronic information map which could show the occurrence and distribution on variety of diseases and pests (Fig.1).

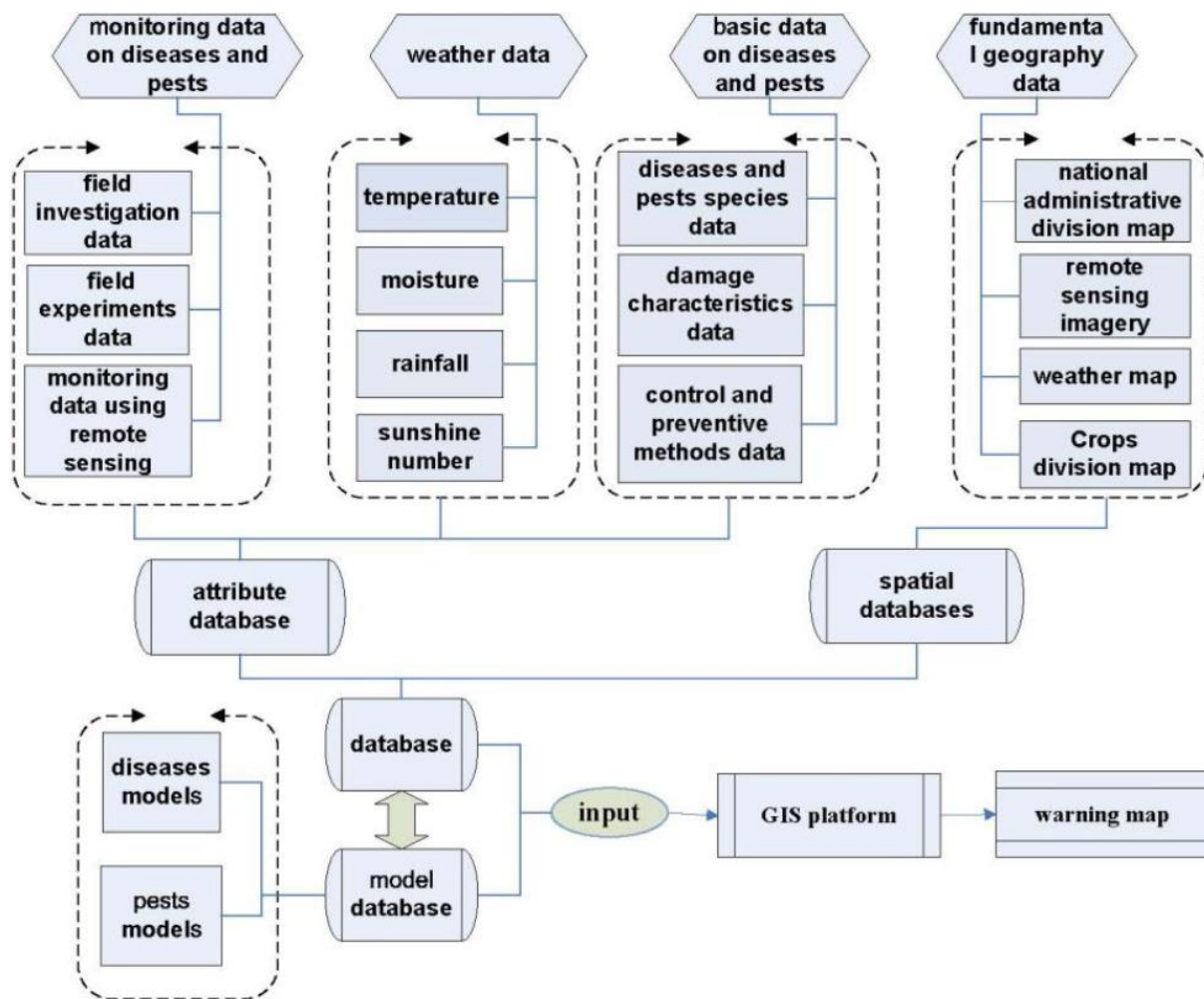


Fig.1. Flow chart of warning system for diseases and pests

FORECASTING METHODS

Some of forecasting models were developed, which are describe below.

Forecasting Leaf Spot Diseases on Cereals

It is important to study relationships between weather and plant diseases in supervised controls. In Sweden the influence of rainfall before and during heading in winter wheat has been studied. A strong correlation was found between rainfall and attack by *Septoria spp.* Such information can be helpful when assessing the need for chemical treatments against leaf diseases.

Wheat Blossom Midge

During some years wheat blossom midge (*Contarinia tritici* and *Sitodiplosis mosellana*) are of great economic importance in winter and spring wheat. Severe attacks by the larvae cause considerable yield losses amounting to 20-30% in some fields. However, severe attacks are infrequent, which is an important fact to consider when making a decision on spraying. For more than 20 years, annual surveys have been carried out every year in wheat fields in central and southern Sweden. In each field, kernel sampling has been carried out to obtain information on wheat midge



populations. This information together with weather data during the growing season allows the risk of attack by the midges to be estimated.

Future Aspects on Forecasting Pests and Diseases

Further improvements of forecasting systems for pests and diseases on field crops rely on close collaboration between researchers, advisory services and farmers, especially for validation and implementation of methods. The research and development of current forecasting methods included validation using field-specific data from more than 3,000 fields of different crops. In addition, weather data have been included in the models to improve them. In the near future the availability of forecasting methods via the internet will increase and thereby improve the possibility for farmers to have direct access to new models for specific fields.

Conclusion:

A warning and information system for diseases and pests of crops was established based on Geography Information System (GIS). The occurrence and damage of major diseases and pests of crops could be monitored and forecasted in real time by using the system, based on the forecasting model. And the system could submit warning maps with six colors and words information to the users. By using the system, we could standardize the forecasting data collection; transmit information through network and forecasting results viewable. Users could use it to classify and predict diseases and pests also could use it to select fitting time and technology to control.

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