

DEVELOPMENT AND USE OF EXPERT SYSTEMS IN PLANT PATHOLOGY

Date: 20-03-2020

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- Expert systems are computer programs that try to equal and, better yet, surpass the logic and ability of an expert professional in solving problems, the solutions of which require experience, knowledge, judgment, and complex interactions. The dependability of an expert system is proportional to the knowledge of the expert(s) who produced it. Expert systems can use data in almost any format and can suggest a solution to the problem; they can even use incomplete or incorrect data, as long as the degree of certainty of data is quantified by the expert and is included in the knowledge base. Expert systems in plant pathology are used frequently for diagnostic purposes, i.e., identifying the cause of a disease by the symptoms and related observations.

- Several expert systems, however, incorporate the decision-making process of the expert and advise producers in making disease management decisions. By incorporating infection models of the important diseases of a crop into the knowledge base of the computer, the expert system can advise growers of disease potentials on the basis of the actual occurrence of infection periods and provide pesticide recommendations and suggestions for pesticide amounts and timing of application.

- The development of even simple expert systems is quite complex, but advances in computers and increasing familiarity with their use are making the development and use of expert systems increasingly attractive. In their simplest form, expert systems utilize a bank of data pertinent to the problem stored in the computer and also a knowledge base inputted by the expert(s) and consisting of one or more “IF conditions” followed by a conclusion or action (THEN action) and, finally, a recommendation.

- In addition to the requirement of being familiar with computer programming, the most important part of creating an expert system is the quality (expertise) of the expert(s) providing the knowledge that is inputted in the system. This knowledge of the expert(s) is then represented in a form that can be converted into computer code. Once a prototype expert system is generated, it is first tested for logic and accuracy. Usually, the expert system is also reviewed and, if necessary, revised by other experts; subsequently, it is tested with the intended users, and additional revisions are made before the expert system is released for use. Even after an expert system is released to its final users, it must be revised and updated regularly.

- **BLITECAST** (1975), which is a computerized forecasting system for potato late blight, and the computer based apple scab predictive system (1980) are considered to be the precursors to expert systems. The first expert system in plant pathology was developed in 1983 to diagnose nearly 20 soybean diseases in Illinois. Since then, expert systems have been developed for the diagnosis or management of diseases of tomato (**TOM**), grape (**GrapES**), wheat (**CONSELLOR**),
- peach and nectarine (**CALEX**), apple (**POMME**, the Penn State apple orchard consultant **PSAOC**), wheat (**MoreCrop**), and others.

- An example of an “expert” advisory system is More-Crop, which stands for “Managerial Options for Reasonable Economical Control of Rusts and Other Pathogens.” MoreCrop is designed to provide disease management options in different geographic regions and agronomic zones of the Pacific Northwest using the vast information available on wheat diseases as well as advances in computers. The components of MoreCrop and their functional relationships are understood. Some of the frames (“windows”) of the program show the wheat diseases about which one should be concerned. Brief information about each disease, suggestions for disease control through seed treatment and foliar spray, timing of sprays, spray label restrictions, and which diseases can or cannot be controlled through a particular treatment are shown in relevant frames.

- Expert systems are used primarily, but not exclusively, with high value horticultural crops that require frequent application of pesticides as part of their disease and pest management, usually in response to site specific weather conditions. Although expert systems are aimed for use by growers of such crops, they are also used by individuals, such as county agents and pesticide distributors, who influence grower decisions.

DECISION SUPPORT SYSTEMS

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Decision Support Systems (DSS)

- It is apparent that the development and usage of DSS will become more regional rather than local. The continuing demise of the family farm and the increase in large farms, however, are expected to increase the use of DSS systems significantly.

Decision Support Systems (DSS)

- Cooperation among universities,
- growers, and industry has resulted in the development
- of the Penn State apple orchard consultant in
- the United States, while in Australia, development of the
- AusVit DSS for grapes came about through the cooperation
- of several state departments of agriculture,
- universities, grower organizations, and private industry.



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Decision Support Systems (DSS)

Many of them have plant disease management modules, such as WISDOM for potatoes by the University of Wisconsin, RADAR for apples by the University of Maine, PAWS for several crops by the Washington State University, and another one, Fieldwise.com, used on several crops on the west coast. Of the many available DSS systems, relatively few are used because they address only specific disease problems, they are too complex to operate, or for other reasons.

Decision Support Systems (DSS)

A fully developed decision support system (DSS) is supposed to collect, organize, and integrate all types of information related to the production of a crop, to subsequently analyze and interpret the information, and to eventually recommend the most appropriate action or action choices.

Decision Support Systems (DSS)

Decision support systems for plant disease management may be very simple, e.g., a data processing device, fairly complex, e.g., a computerized expert system, or extremely complex, including automated weather and combinations of decision aids and expert systems, as well as multidisciplinary teams of knowledge specialists.

Decision Support Systems (DSS)

- Numerous DSS systems available are aimed to assist practitioners in the field, including county agents, crop consultants, growers, and others.