

# Pest Activity Prognosis in the Rice Field

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## INTRODUCTION

In crops management, it is important to estimate the damage effected by pests since the degree of damage will determine the level of pest activity. Pest activity usually involves their life stage and its presence in the field. In addition, pest management in crops is a crucial problem and may yield losses if it is not handled properly. Consequently a forecasting tool is needed to predict the level of pest activity. This is important so that an early treatment or action can be applied before more damage to the plant occurs.

Accordingly, the fuzzy expert system may facilitate the user through a consultation session in order to forecast the pest activity in the rice field. A set of questions will be asked to help users diagnose their given symptom in order to infer such a conclusion. Figure 1 shows the main components of an expert system including inference engine, expert, knowledge base, working memory, and user interface. The consultation performed by the expert system also involves fuzzy logic to deal with the natural and uncertainty data. Besides, all the information and knowledge about the pests, treatment control measures and prevention steps are managed in the specific knowledge base created in the system. This system is able to educate and inform the farmers and smallholders about pests and their activities in the rice field.

## BACKGROUND

Sustainable agriculture is a key element of sustainable development and essential to the future well-being of the planet. Sustainability aims to achieve adequate safe and healthy food production, improved livelihoods of food producers, and the preservation of non-renewable resources. The demands of a growing world population for food and fiber require world agriculture to produce higher yields from less cultivated land. Recently, the emerging need for hybrid intelligent systems

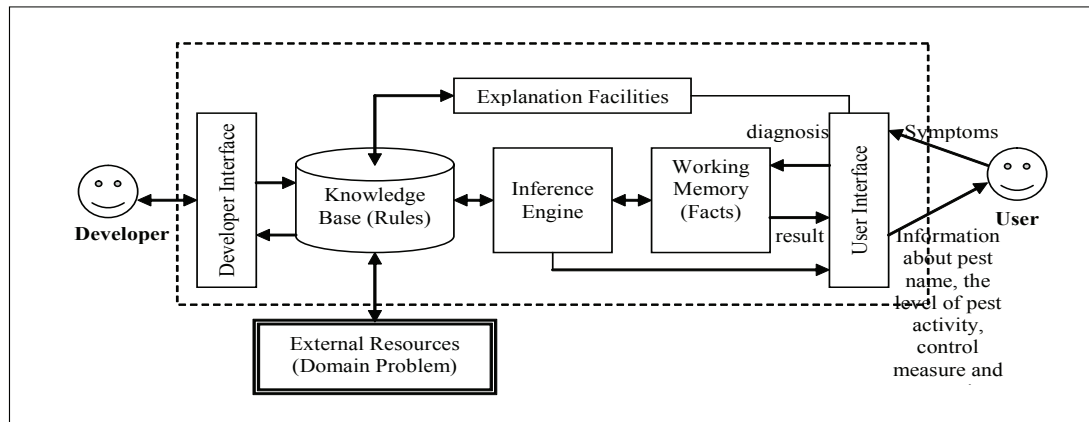
(HISs) is motivating important research and development work. The integration of different learning and adaptation techniques to overcome individual limitations and achieve synergetic effects through hybridization or fusion of these techniques has in recent years contributed to a large number of new intelligent system designs (Abraham & Nath, 2001). This integration aims at overcoming limitations of individual techniques through hybridization or fusion of various techniques.

In the past decade, a great many expert systems—such as office automation, science, and medicine including agriculture—were developed and applied to many fields. At the initial stage of agriculture expert system development, the focus was on diseases diagnosis and pests of various crops. In recent years, research and development of the expert system fields of the agriculture domain received much attention by many countries. The difficulty of problems confronting farmers are yield losses, soil erosion, diminishing market prices from international competition, increasing chemical pesticide costs, pest resistance, and economic barriers. Hence, farmers need such an application or tools to assist with various knowledge and information, especially in their farming operations.

## PEST ACTIVITY PROGNOSIS

Pest management in agriculture is a pest control strategy that coordinates and uses a combination of methods to meet individuals' production goals in the most economical and environmental manner. In short, it is based on understanding the farm's ecology. The basic components of pest management include acceptable pest levels, preventive cultural practices, monitoring, mechanical controls, biological control, and chemical control. It is apparent that that farm's monitoring and prevention endow with significant contribution to reduce losses.

Figure 1. Expert system components



The management of pests in crops is a highly challenging problem and may yield losses if not handled properly (Saini, Kamal, & Sharma, 2002). Potential losses of up to 55% before harvest have been estimated, but these estimates often represent the worst case or highest levels of loss. Consequently, different technologies are needed as well as awareness programs for effective, economical, environment-friendly control of pests (Singh & Singh, 1990). Besides, the appropriate and optimal combination of control measures are used for cost-effective and environment-friendly control of pests (Atwal & Dhaliwal, 1997).

It is important to manage and control the pest occurrences and their activity in the crop fields. Pests in crop management involves birds, snails, worms, rats, and others. Good field practices to protect and sustain the field require proficient knowledge and information. Here, farmers are encouraged to learn their farm, observe and monitor, and use their knowledge and experience to decide on actions. They may also seek advice from farm experts (researchers and governmental representatives). Consequently, the transfer of expert knowledge and extension information to the farmers plays a key role in educating this community. The understanding of the farmers is further increased through experimentation and knowledge sharing. For that reason, an expert system seems to be beneficial to vary the knowledge sharing and reasoning. Expert system offer a program that uses available information, heuristics, and inference to suggest solutions to problems in a particular discipline. While such systems do not often replace the human experts, they can serve as useful assistants. Expert systems will play a major role in the dissemination and application of useful knowledge leading to economic growth and higher standards of living.

It is not only providing expert knowledge, but potentially become learning resources to help farmers develop their own expertise.

On the other hand, as knowledge involved in pest management is imperfect and fuzzy logic has been successfully used for approximate reasoning in such cases, its application becomes mandatory to manage the uncertainty in the expert system (Zadeh, 1983). Appearance of damage at a farm does not always promise identification of the pests. Crop damage is never complete and usually expressed linguistically as very low, low, medium, high, and very high. Moreover, the partial truth values of existing pest symptoms may strengthen pest identification. The value of pest occurrence symptoms is also captured in fuzzy terms such as few, many, light, and many more. Due to the imperfect, vague, and not completely reliable knowledge involved in pest activity and damage level in the rice fields, it is difficult to measure the symptom occurrences with simply yes or no, or absence and presence notation. The crisp rules may not be precisely appropriate for pest identification (Pasqual & Mansfield, 1988). For instance, the existence of larvae in the leaves cannot be simply expressed by the 'yes' or 'no' value.

However, the existing expert system allows the user to answer the set of questions using the rigid crisp values (Saini et al., 2002). In crops management, it is important to estimate the damage that has been affected by pests, since the degree of damage will determine the activity of pests (Atwal & Dhaliwal, 1997). Therefore, there is need for a forecasting tool that can predict the level of pest activity so that early treatments can be applied to crops before the damage becomes worse. Hence fuzzy logic helps to cope with the precise damage symptoms for pest activity estima-

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