Development of a matrix-based, multi-media diagnostic key to sweetpotato problems

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Abstract

An interactive key for diagnosing problems in sweetpotato has been developed through collaboration between The University of Queensland (UQ), the International Potato Center (CIP) and the Philippines Rootcrops Research Institute (Philrootcrops), with funding from the Australian Centre for International Agricultural Research (ACIAR), who will publish the key on CD-ROM. A network of international experts has contributed information on each of the 73 problem causes covered by the key, which include insect and nematode pests, fungal, bacterial and viral pathogens, and nutritional disorders. The key is based on Lucid™ software, developed by UQ's Centre for Biological Information Technology (CBIT). It utilises a matrix key, which allows the users to select whichever symptoms or signs they observe on a specimen, to reduce the number of possible causes. This is distinct from a dichotomous or pathway key, which requires choices to be made in a defined order. Each problem cause is described in an illustrated fact sheet, which can be accessed from the key or from the CD's home page. Also available from the home page are informative sheets on sweetpotato biology and crop management. Following prototype development, the key was field tested in a number of countries with various user groups, including extension workers, students and researchers.

Media summary

An innovative new software product offers sweetpotato workers a one-stop shop to help identify and manage sweetpotato crop problems.

Keywords

Diagnosis, Lucid, Agricultural extension, Expert system, Decision support system

Introduction

Sweetpotato has a capacity for very high yields, but outcomes for farmers, particularly in developing countries, are usually a fraction of the crop's potential. There are many possible yield limiting factors, and most can be controlled to some extent by farmers, if they are well informed. Correct diagnosis of a problem is a vital first step in its management. The necessary second step is accessible information, which is appropriate to the farmers' resource base and the management options relevant to them.

In many crop situations, information about the symptoms and other aspects associated with the various causes of crop disorders are discipline based and published in separate publications. Agricultural extension agents and farmers not only find it difficult to track down relevant information but are often faced with a situation where the information has not been integrated and therefore cannot be easily used for diagnostic purposes. Since symptoms caused by plant diseases may be very similar to those associated with insect feeding or nutrient deficiency, for example, a diagnostic guide to plant diseases may result in misdiagnosis of the problem. What is required is a guide that brings together all the relevant information about crop disorders and provides assistance in diagnosing unidentified problems.

A number of computer-based diagnostic guides or keys have been developed for CD or Internet use for a number of crops. For example, a brief web search found the following:

- Poinsettia problem diagnostic key (North Carolina State University, 2004)
- Herbicide Injury Diagnostic key (University of Wisconsin, 2004)
- Purdue University Crop Management CD Series (Purdue University, 2004)
- Digital diagnostic system for ICRISAT crops (ICRISAT, 2004)

While these keys provide growers and advisors with useful information, since many of them are dichotomous keys that have been constructed using HTML editors, they have a number of disadvantages, associated with the:

- Time involved in constructing HTML dichotomous keys, particularly to put much larger keys on to the Internet, since each key is a one-off;
- Difficulty of updating keys when additional information becomes available or a key needs to be modified for other locations or purposes;
- Inability of dichotomous keys to accommodate variable symptom expression and provide users with other functionality in facilitating an identification.

To overcome these problems, generic key systems, such as the Lucid system (Lucid, 2004), have been developed, providing a much more powerful identification or diagnostic system and one that enables key developers to input and modify their key data and multi-media easily, using a specialised key building program. Lucid has been used to produce a number of taxonomic keys, published either on CD-ROM or on the Web. Its use for diagnostic keys is more recent, and the sweetpotato key is the first multidisciplinary crop diagnostic tool developed using Lucid.

The multi-media diagnostic key for sweetpotato problems described in this paper has been developed through a project funded by the Australian Centre for International Agricultural Research, involving collaborators from Philrootcrops in the Philippines, the International Potato Centre and The University of Queensland. The project has focussed on the needs of users in SE Asia, and particularly the Philippines, although the key has been scored for other growing regions. The key is intended for use by farmers, advisors, students and researchers, but is particularly targeted at extension workers in developing countries.

The diagnostic key

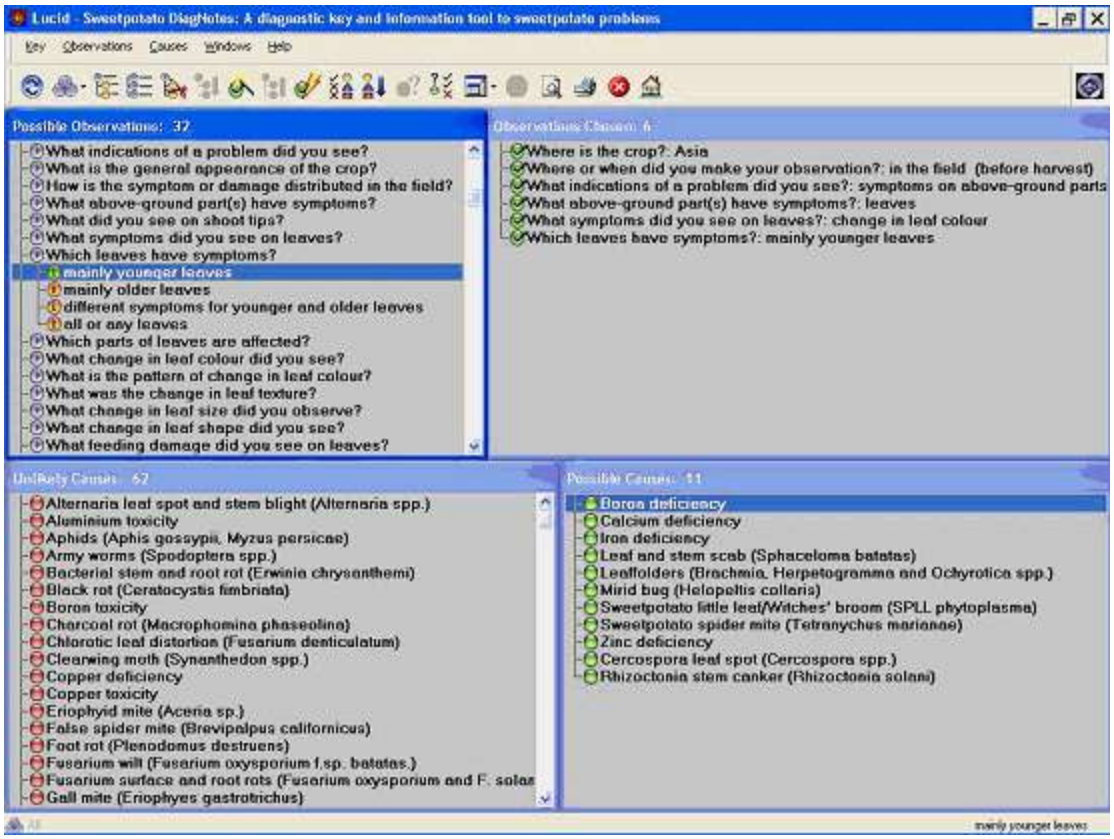

Figure 1. Screen layout of the Sweetpotato Diagnotes key.

The Lucid system employs a matrix key, in which each potential problem cause is scored against every character state listed in the key. Users may select any character state in any order, in order to reduce the number of possible causes. In a traditional dichotomous key, questions must be answered in a specific order for the diagnosis to proceed. However, symptoms or signs may vary with the stage of the crop or the stage of the problem development, and among the different parts of the crop, including the soil, only some of which may be available to the user in a specimen provided by a farmer. Using a matrix key, any information available may be used to shorten the list of possibilities.

The screen layout (Figure 1) presents the user with four windows. The top left window contains a list of Possible Observations, and the bottom right a list of Possible Causes. As observations are chosen, they appear in the top right window, and any causes rejected by that choice are moved to the Unlikely Causes window. The choice can also result in redundant questions being removed from the Possible Observations list, so that relevant questions are easier to find. The software also provides a range of other tools to help users find the most relevant questions to separate remaining causes.

Each entry also has an information link, via the coloured button to the left of the text. Thus many character states are illustrated with photographs of typical examples (Figure 2). Choices can be made directly by selecting the photos, a popular feature with less literate users. While the key does not attempt a taxonomic identification of insect pests, an image gallery of insects, both pest and beneficial, is provided.

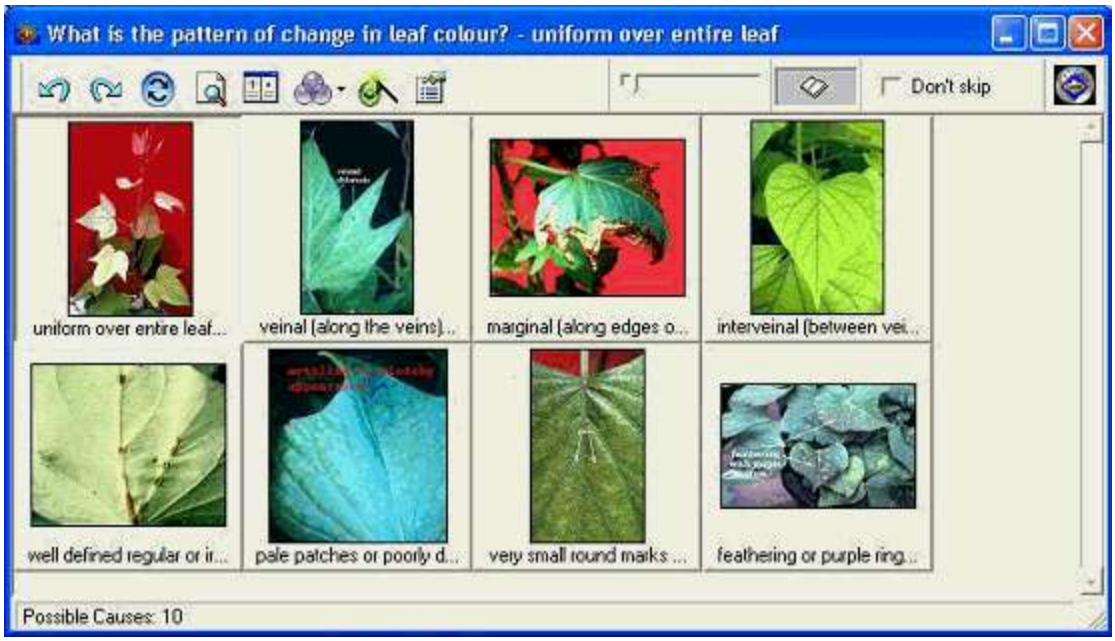

Figure 2. A typical window of images depicting alternate character states.

Each possible cause is linked directly to an illustrated fact sheet about the pest, disease or disorder. Each fact sheet opens at a single-screen summary page (Figure 3) containing information for confirming the diagnosis, and bookmarks to subheadings in the main fact sheet.

Since Lucid supports html, an important attribute of the key is that users can navigate through the content either through the key, by accessing this information from lists of insect pests, diseases, nutrient disorders, etc, or by using a key word search facility. Information on specific disorders is also supported by general information on crop biology and management. Additional facilities are a glossary linked to each occurrence of specialist words, and an interactive tutorial on use of the key.

During the course of the project, a number of workshops, training courses and field trials were organised to get feedback on earlier versions of the CD product and to assess its value as a training and decision support tool. Extension officers were impressed with the ease with which relevant information about specific problems could be retrieved. However, while most extension personnel have adequate access to computers to run the CD, others do not. At the request of extension officers, a pocket field guide was produced (Amante et al, 2003) covering the most commonly encountered disorders.

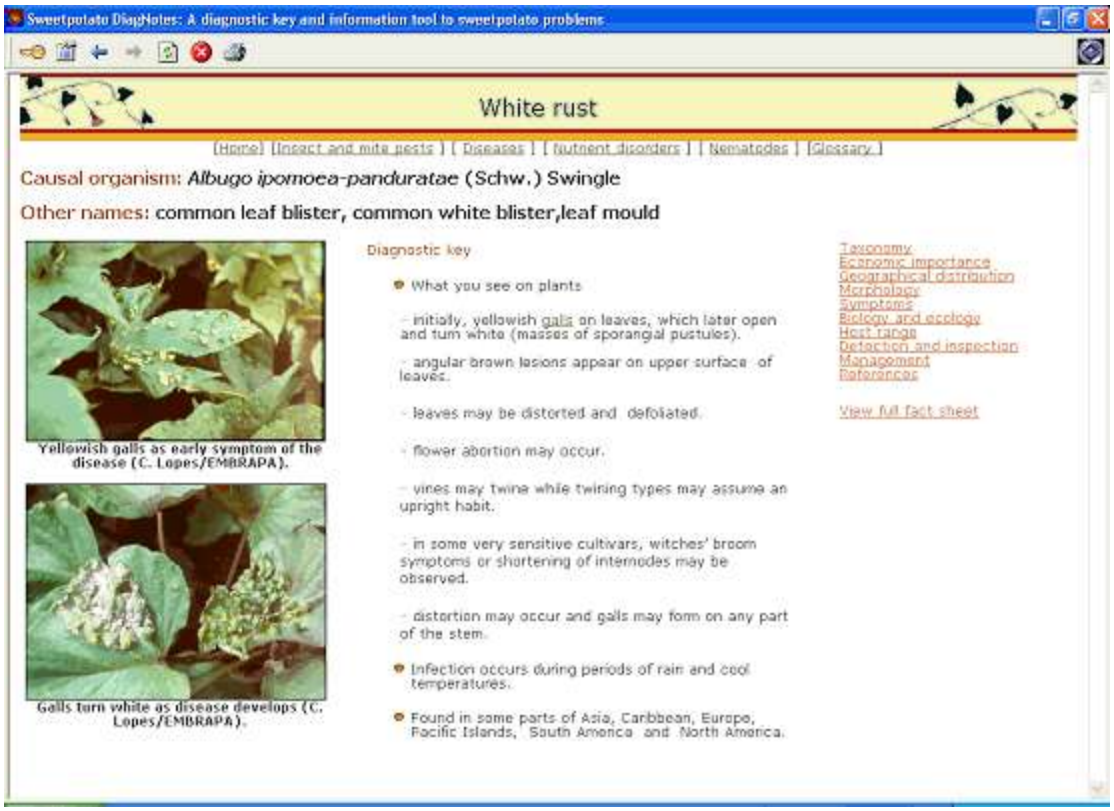

Figure 3. Diagnostic summary page for white rust of sweetpotato, with links to full text of the fact sheet.

Three impediments to future adoption and use of this sweetpotato key have been identified.

1. To continue to be of value, the content of the key needs to be updated at regular intervals. Indeed, a major advantage of producing an electronic tool for diagnosing crop problems is the relative ease with which the product can be updated and re-issued. For example, additional content could be incorporated to meet specific needs of users in Africa or the Americas.

2. Since the main target audience of the CD is extension workers, the fact that the content of the CD is in English will constrain its use in certain countries.

3. Finally, the limited availability of computers is currently an impediment to the use of the CD product, but this problem is steadily diminishing.

One way to increase potential users' access to the sweetpotato key would be to put it on an Internet site. A number of Lucid keys are already delivered in this way (Lucid, 2004) and, with the imminent release of the new Java-based, Lucid applet player , this would be an even more attractive option to casual users, since they would not need to have a player installed on their hard drive.

References

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