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Knowledge based system for weed seed identification

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ABSTRACT

The term 'weed' always has a negative connotation not only by its presence as a plant but as a seed also. The movement of most of the weeds from one location to the other is mainly through their seeds. Correct identification of weed seeds is therefore necessary for strict quarantine to check the spread of weed seeds from one place to another. Accurate identification of weed seeds requires skill and good judgment on the part of the examiner and it is a difficult task for a layman. Therefore, availability of a state of art technology for identification of weed seeds is very much needed. For identification of weed seeds, a Knowledge Based System (KBS) contains information about 120 weed seeds with 11 parameters each has been developed at the Directorate of Weed Research, Jabalpur (India) using Visual Basic. Net as front-end application and MS Access as back-end application with user-friendly menus**.** In this study, a rule based system for identification of weed seeds was developed that helps the stakeholder in identifying the weed seeds.

Key words: Identification, Knowledge Base, Software, System, Weed seed

All definitions of "Weed" usually reflect the damage or loss caused by weed as a plant. But actual weed problems start with weed seeds. Weed seeds serve as a primary source of new populations on the site of their production or elsewhere. The weed seed contaminants in the crop produce cause quality deterioration and weed seeds in grain crops perpetuate when the seed is used to raise the crop. On occasions, the agricultural producers or other professionals will be challenged to identify a weed by the features of its seed. Accurate identification of weed seeds is necessary for the correct labeling of seeds moving in commercial channels which require skill and knowledge.

The task of identifying weed seeds is difficult due to smaller size of many seeds, the differences in maturity, the loss of certain parts and the changes in surface appearance caused by processing or handling and difference in size and colour which occur under different soil and climate conditions. Some of the difficulties in identifying the weed seeds is lack of familiarity with the terms, failure to observe closely important features of the seed, lack of general knowledge in that area, and the fact that description of one observer does not always convey the intended information to another observer. The Knowledge Based System (KBS) for weed seed identification were developed to assist persons involved in identification of weeds by their seed.

KBS can be defined as a tool for information generation from knowledge. Information is either found in various forms or generated from data and/or knowledge. Text, images, video, audio are forms of media on which information can be found, and the role of information technology is to invent, and devise tools to store and retrieve this information.

Agricultural KBS is a Decision Support System that helps the Agricultural Extension agents, who have to identify the problem and advice the farmers to take action, based on the observations from the fields or from the expert systems (Prasad and Vinaya Babu 2006). It is one of the most efficient extension tools to take the technology from scientists to the farmers directly without any dilution of content which normally creeps in because of the number of agencies involved in normal technology transfer systems.

Most of the institutes under Indian Council of Agricultural Research (ICAR) developed the KBSs for various aspects including crop production, disease management, farming system research, poultry management, animal husbandry, *etc.*

KBS for field crops are implemented for: identification of weed seedlings (Naidu *et al.* 2013), rainfed natu tobacco germplasm (Ravisankar *et al.* 2009), identification of weeds in cereals (Gonazalez *et al.* 1990), wheat crop management (Kamel *et al.* 1994), diagnosis of soybean diseases (Michalski *et al.*

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1983), crop management for cotton (Lemon 1986) and (Plant 1989) and weed identification for wheat (Schulthess *et al.* 1996). KBSs were also implemented for horticulture crops: apple orchid management (Roach *et al.* 1985, Gerevini *et al.* 1992) and cucumber production management (Rafea *et al.* 1995). In the present study, a rule based system (Ajith Abraham 2005) for identification of weed seeds was developed which enables the extension personnel, researchers and farmers in identification of weed seeds and there by managing weeds in crops and maintenance of quality of crop produce.

MATERIALS AND METHODS

KBS on weeds seeds was developed with the combined effort of domain experts and software professionals. Based on the information collected on different weed seeds, a data sheet has been prepared with 11 characters and 'Scientific name' is considered as a primary key for managing the records. Using this datasheet, a knowledge base was developed which contains information about 120 weed seeds with 11 parameters each. This system was developed using Visual Basic .Net (Balena 2005) as front-end applications and MS Access (Teresa *et al.* 2010) as back-end applications with user-friendly menus.

System design (Kiong 2005) composed of several basic components: a user interface, database, knowledge base and an inference mechanism (Figure 1). System development usually proceeds through several phases including problem selection, knowledge acquisition, knowledge representation, programming, testing and evaluation. In the knowledge base, information on weed seed can be stored as rules of inference that are used during the reasoning process for knowledge extraction of weed seed characteristics. These rules may be if…then…else nature or any other valid form. The inference mechanism guides the Fig. 1.

KBS Design Architecture reasoning process through knowledge base by attempting to match the facts in the database to other rule conditions. Inferences are identified to meet the user requests to find availability of the data in weed seed knowledge base. The transactional data from operational sources are fed into the database which in turn converts into facts and rules.

To use the system easily, the user friendly interface was developed with Graphical User Interface (GUI). The three major activities considered in designing the system are 'Weed-seed information, Search–Query, Weed thumbnail'. These three options allow the user to identify the weed seed characteristics by selecting family name (or) scientific name (or) seed photo. These fields were created with text boxes for data entry / modification and label boxes for title of the text. Image(s) of seed and plant photograph are embedded in the knowledge base itself. Based on the knowledge base, application software has been developed which consists of 4 modules. The multiple document interface (MDI) form of the software (Figure 2) consists of 4 options, *viz.* 'Masters, 'Details', 'Reports', and 'Help'. At present, data related to 120 weed seed were fed into the software system, for storage and accessing. Open Data Base Connectivity (ODBC) has been provided to access the data from the database with the developed application.

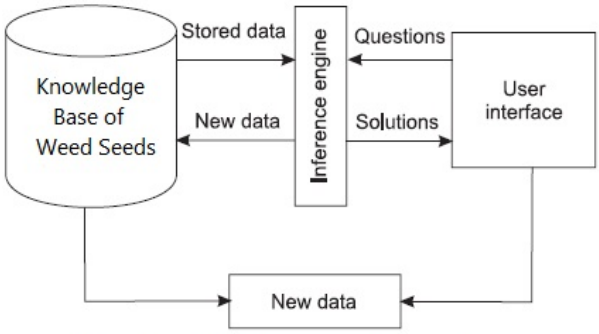

Fig. 1. KBS Design Architecture

RESULTS AND DISCUSSION

The main menu of this software consisted of 4 modules, *viz*. Weed-seed information, Search – Query, Weed thumbnail, About e-module and Exit (Fig. 2). The scientific names of plants were considered as primary key for identifying the characteristics of weed seeds.

Weed-seed information: It was a simple search mechanism which allows the user to search for a particular weed seed by its scientific name. For easy searching, all the scientific names are arranged alphabetically and placed into different subgroups, *viz*. A-D, E-H, I-L, M-P, Q-T, U-X, Y-Z. For example if the user is searching for the weed seed characteristics of a plant with scientific name as "*Cleome viscose* L." then user has to select the subgroup A-D, then a list of scientific names gets displayed. By selecting '*Cleome viscose* L.' from the list, the information, *viz*. Bayer code, family name, common name, seed photograph and plant photograph along with seed characteristics, *viz*. size, color, shape, surface and remark gets displayed as shown in (Fig. 3). Search-query: Through this

Fig. 2. Main menu

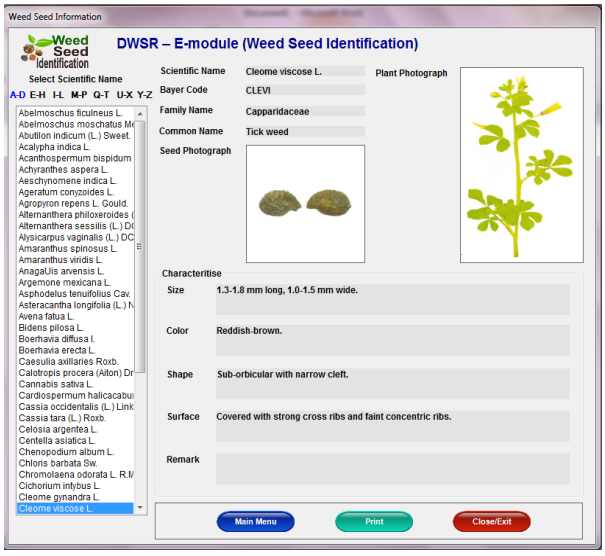

Fig. 3. Weed seed information menu

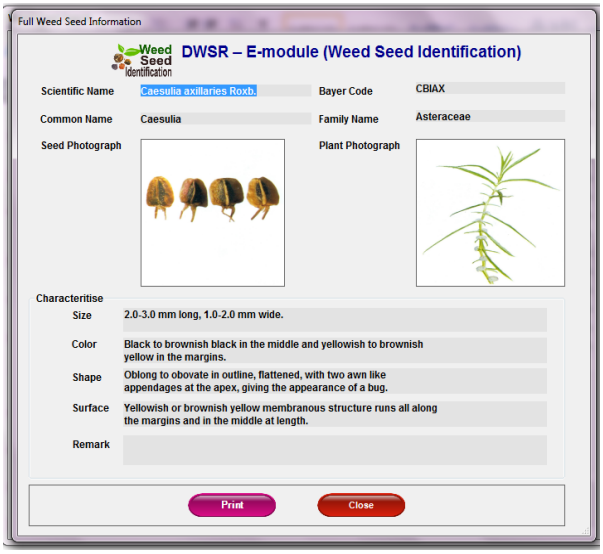

Fig. 4. Search by family name

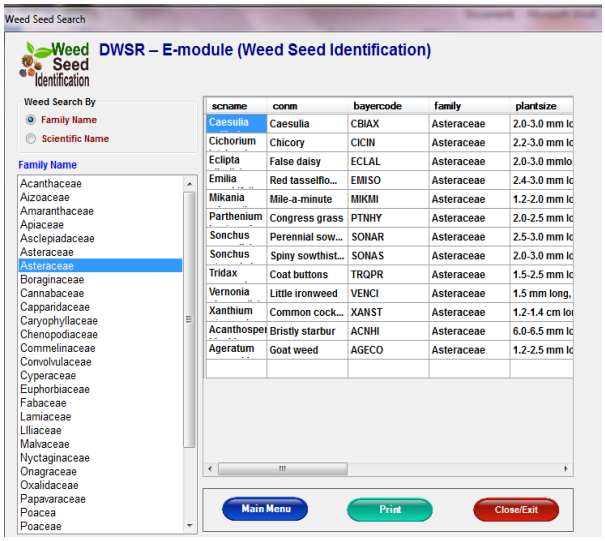

Fig. 5. Weed seed identification - output

option, the user can make a query for a particular weed seed by selecting either 'family name' or 'scientific name' of the weed. If user selects the 'family name' then list of names will be displayed in alphabetical order. In each 'family name' list of 'scientific names' of weed plants are stored which belong to that family. For example, if the user selects the 'family name' as *Asteraceae*, then list of 'scientific names' of that family with other parameters, *viz*. Common Name, Bayer Code, Family, Seed size, Shape, Color, Surface, Remark along with Seed image, Plant image' gets displayed on the leaf pane of the menu as shown (Fig 4). Then the user can select one of the scientific name like *Caesulia axillaries* Roxb whose characteristics gets displayed in a new windows as shown (Fig. 5).

Similarly by selecting the 'Scientific name' in 'Weed search' option under 'Search-Query' menu, list of scientific names of the weed plants gets displayed on the left pane of the menu. By selecting one of the names, its characteristics get displayed in new window.

Weed thumbnail: The third module allows the user to perform the search by viewing the list of seed photos. A list of seed photos with their scientific names gets displayed after selecting this option from the 'main menu' (Fig. 6). By choosing one of these 'photographs' from the list it will display the characteristics of that weed seed in the new window.

About e-module: This option is self-explanatory that includes the information for step-by-step execution

Fig. 6. Search by seed photograph

of this software. This is portable software, which makes possible to execute this software in any system. For this, a 'SETUP' program is created (executable file) including all the files and data. Any user can install this software by running this 'SETUP' program and the execution of the software is self-explanatory. In all menus, three navigation toolbars were created, *viz*. 'Main menu, Print and Close/Exit' option. The user is allowed to take the hard copy of the selected report in any menu, switch to 'main menu' from the current window and close the current window.

From the researchers point of view, knowledge based systems have a potential to help to organize and synthesize knowledge and information of different types. It is possible to focus and apply diverse avenues of research to solve difficult problems, link together quantitative data, simulation models and basic research results into knowledge base. The idea of a KBS is shifting the focus of the research community to knowledge dissemination in contrast to knowledge accumulation. This system serves as a delivery system for extension information and management of decision makers. It also plays an important role for accessing instant information in an easily understood form with embedded images in the database itself for identification of weed seeds. Further modification to the existing system is a continuous process based on the information and suggestions received from various users / researchers.

REFERENCES

Ajith Abraham. 2005. *Rule-based Expert Systems. Handbook of Measuring System Design* edited by Peter H. Sydenham and Richard Thorn. John Wiley & Sons, Ltd. ISBN: 0-470-02143-8.

Balena F. 2005. *Programming Microsoft Visual Basic .NET.* Microsoft Press, USA.

Gerevini A, Perini A, Ricci F, Forti D, Ioratti C and Mattedi l. 1992. POMI: An Expert System for Integrated Pest Management of Apple Orchards. *AI Applications* **6**(3): 51-62.

Gonazalez-Andújar JL, Rodriguez J and Navarrete L. 1990. Development of a prototype expert system (SIEXMAL) for identification of weeds in cereals. pp. 429–434. In: *Proceedings of the European Weed Research Society, Integrated Weed Management in Cereals*, Helsinki, Finland.

Kamel A, Schroeder K, Sticklen J, Rafea A, Salah A, Schulthess U, Ward R and Ritchie J. 1994. Integrated Wheat Crop Management System Based on Generic Task Knowledge Based Systems and CERES Numerical Simulation. *AI Applications* **9**(1): 17- 27.

Kiong SW. 2005. *MobES Expert System*. http:// www.generation5.org/content/2005/MobES

Lemon H. 1986. COMAX: An expert system for cotton crop management. *Science* **233**: 29-33.

Michalski R, Davis J, Visht V and Sinclair J. 1983. A computer-based advisory system for diagnosing soybean diseases in Illinois. *Plant Disease* **67**: 459-463.

Naidu VSGR, Ravisankar H, Sandeep Dhagat, Virendra Kamalvanshi and Sharma AR. 2013. Expert system for identification of weed seedlings. *Indian Journal of Weed Science* **45**(4): 278-281.

Plant R.1989. An integrated expert decision support system for agricultural management. *Agricultural Systems* **29**:49-66.

Prasad GNR and Vinaya Babu A. 2006. A Study on Various Expert Systems in Agriculture. *Georgian Electronic Scientific Journal: Computer Science and Telecommunications* **4**(11): 81-86.

Rafea A, El-Azhari S and Hassan E. 1995. Integrating Multimedia With Expert Systems For Crop Production Management. In: *Proceedings of the Second International IFAC Workshop on Artificial Intelligence in Agriculture*, Wageningen, The Netherlands.

Ravisankar H, Sarala K and Murthy TGK. 2012. Knowledge-based system for Rainfed Natu Tobacco (*Nicotiana tabacum*) Germplasm. *Indian Journal of Agricultural Sciences* **82**(8): 54-57.

Roach J, Virkar R, Weaver M and Drake C. 1985. POMME: A computer-based consultation system for apple orchad management using Prolog. *Expert Systems* **2**(2):56-69.

Schulthess U, Schroeder K, Kamel A, AbdElGani AM, Hassanein EE, AbdElHady SS, AbdElShafi A, Ritchie JT, Ward RW and Sticklen J. 1996. NEPER-weed: a picture-based expert system for weed identification. *Agronomy Journal* **88**: 423-427

Teresa Hennig, Rob Cooper, Geoffrey L, Griffith and Jerry Dennison. 2010. *Access 2010 programmers reference*. Wiley publications, USA.