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Decision Support System for Nutrient Management in Crops

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SUMMARY

Nutrient Management plays a vital role in increasing crop production, soil upgradation and increase in profitability. Taking these things into consideration, a Decision Support System on Nutrient Management in Crops (DSSNMC) has been designed and developed at Indian Agricultural Statistics Research Institute (IASRI). DSSNMC is a Web-based Decision Support System (DSS) and provides decision to farmers on nutrient management in crops. The system will have great importance in agriculture as experts are not always available to answer farmers' queries. DSSNMC has three modules to provide decision support to farmers in three different situations. First module is the subsystem based on soil test values. Herein, the user gets an advice for fertilizer application based on the information provided for soil test values, crop to be grown, variety of that crop, sowing season, soil type and targeted yield (within a particular range). In case, soil was not tested, then the farmer can use the second module which provides decision support on the basis of location such as zone or district. The system requires information of the location of the farm in terms of zone or district, targeted yield and rest of the values like available nitrogen, phosphorus, potassium and the soil pH are taken from the data base, where standard values for different districts or zones are stored.

Third module of the system helps in controlling nutrient deficiency of standing crops based on abnormal growth as seen through deficiency symptoms shown by the crop. The basis here is the observation of the farmers, which they compare with the images, stored in the system and can use the corrective measures provided by the system. The testing and validation of the system was done using the data of different cooperating centers under All India Coordinated Research Project (AICRP) of Soil Crop Response Correlation (STCR).

Key words: Decision support system, Nutrient management, Web application, .Net technologies.

1. INTRODUCTION

Agriculture continues to remain the major contributing sector of the Indian economy even after 60 years of independence. It contributes 30% of GNP, provides 65% of employment and continues to be primary source of living. The adoption of new agricultural technology brought out the green revolution that boosted agriculture production in India. However, this process has caused nutrient imbalance in the soils due to rapid depletion of soil fertility because of heavy withdrawal of essential plant nutrients by bumper harvests requiring proper nutrient management in the soils. Many studies on soils, chemical fertilizers, plant and their relationship have been carried out, but farmers' queries could not be answered satisfactorily on nutrient management as the information is scattered at different places and the experts are not always available (Watermann 1988). The scattered information can be utilized effectively by the farmers through a "Decision Support Systems" (DSS). The present DSS (Pal 2005) is an attempt in this direction.

The nutrient application in a field is dependent on the nature of the soil fertility in the field i.e. by testing the soil and applying the fertilizers on the basis of relevant soil test values. But many a times, farmers do not have appropriate soil test values and as such under this situation fertilizer application can be done on the basis of soil type of area under cultivation, as has been identified by soil scientists. However, despite of all care many a times, a crop shows deficiency symptoms. In such cases, additional fertilizers can be applied to the crop. Kumar (1992) developed a DSS for micronutrient management in the soils. DSS developed by Patil (2002) provided recommendations on how much of chemical fertilizer is to be applied, instead of dose for a fertilizer source (as farmers require source wise application). The present system based on .net technology provides decision for fertilizer application based on the information provided for soil test values, crop to be grown, variety of that crop, sowing season, soil type and targeted yield (within a particular range).

2. SYSTEM ARCHITECTURE AND REQUIREMENTS

DSSNMC has been implemented in a three layered structure i.e. User Interface Layer (UIL), Application Layer (APL) and Database Layer (DBL). UIL is implemented using HTML (Hyper Text Markup Language) and JavaScript. The User Interface Layer consists of forms for accepting information from the user and validating those forms using JavaScript. APL has been implemented using ASP.NET. ASP.NET is a powerful and flexible technology for creating dynamic Web pages. It is a convergence of two major Microsoft Technologies, Active Server Pages (ASP) and the .NET Framework. ASP.NET is a way of creating dynamic Web pages, using the innovations present in the .NET Framework (Ullman 2005). DBL has been implemented using Microsoft Access 2000. The relational approach has been used to design the database. The fundamentals of normalization theory have been used to normalize different tables of the database (Loney 2004). All tables have proper interaction among themselves via primary key - foreign key relationship. The entity relationship (ER) diagram of DSSNMC is given in Fig. 1.

3. FUNCTIONALITIES OF DSSNMC

DSSNMC is developed as a web-based application, using .NET technology. Therefore, it is platform independent and can be accessed from any computer connected to the internet. The only requirement at the client side is a web-browser. The most commonly used web browsers are internet explorer 6.0 or above from

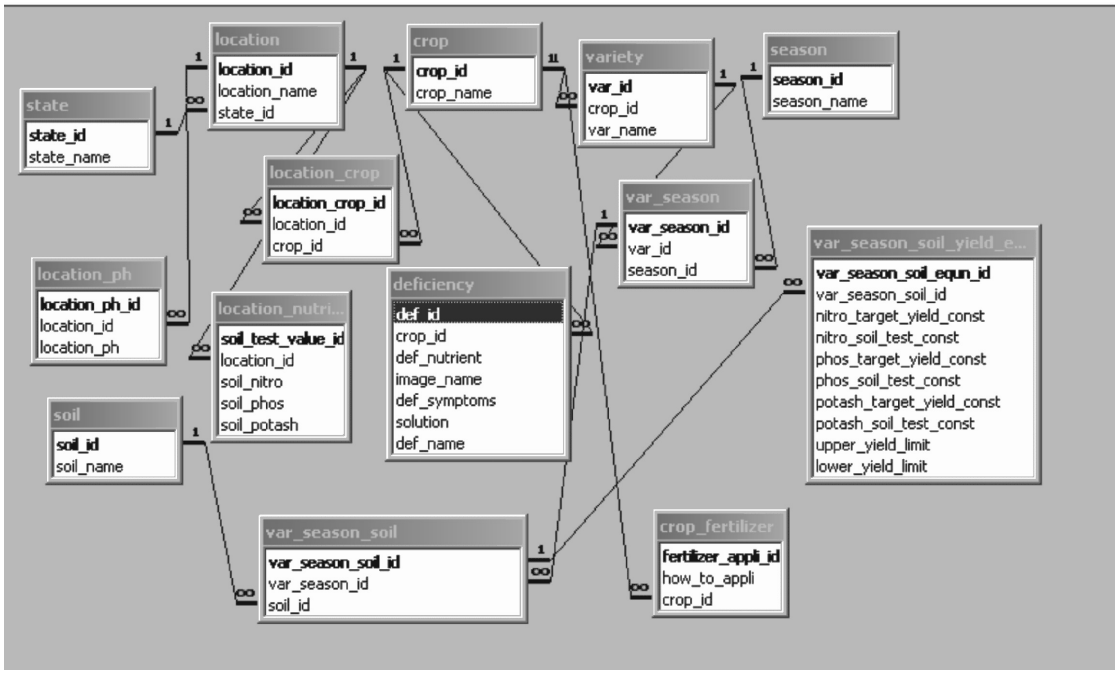

Fig. 1. ER diagram of DSSNMC

Microsoft Corporation and netscape communicator from netscape Communications. DSSNMC successfully runs on both the browsers.

DSSNMC system can be hosted from the server having Internet Information Server (IIS) installed on it. System home page is shown in Fig. 2.

3.1 Type of Users

The system has been designed keeping in view the requirements of two types of users i.e. System Administrators and End Users. Administrators are the users who manage the system and they, therefore, have the right to add, modify, delete or update any part of the information captured in the database. Therefore,

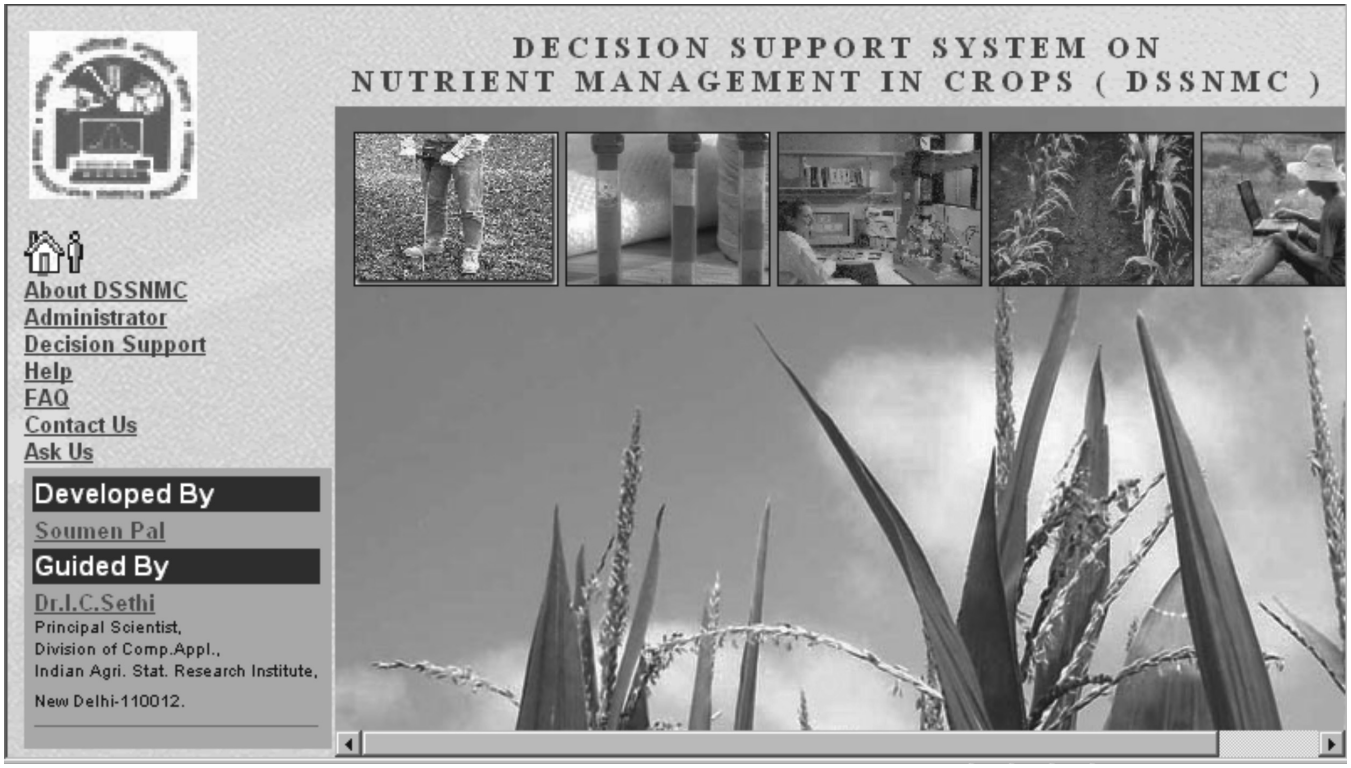

Fig. 2. Home Page of DSSNMC

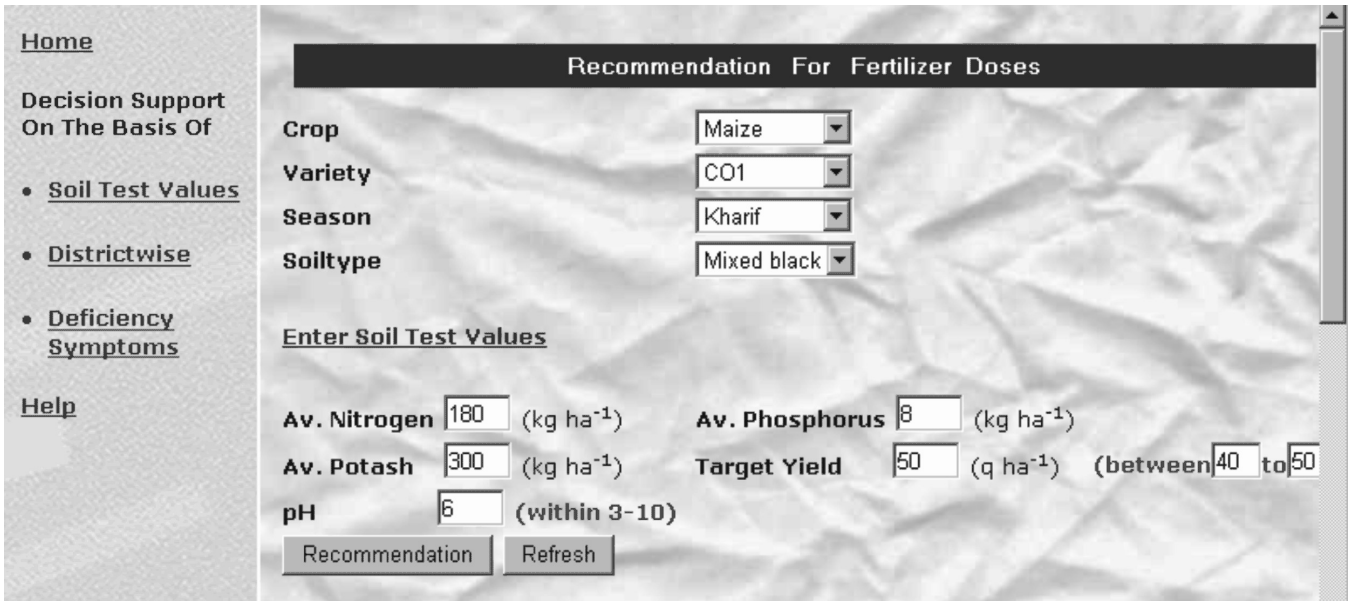

Fig. 3. Information about crop and soil test values

Administrator has user name and password protection for accessing the system. End users are the farmers, who can start the system, and get the desired decision. For this they can start the system and enter the desired data and get the decision from the system. If they do not get satisfied with the advice flashed on monitor, they can view the frequently asked questions, to quench their queries or send e-mail to concerned developers and get the satisfactory answers.

3.2 Decision Support

The present system consists of three subsystems, based on three different situations of decision making for nutrient management in crops. System design strategies for these subsystems are discussed below:

(a) **A subsystem based on soil test values:** In this subsystem, users provide soil test values along with desired crop to be grown, variety of that crop, season for that particular variety, soil type and target yield within a particular range. Recommendation for application of chemical fertilizers (for supplying the requirement of nitrogen, phosphorus and potash) based on above data is provided by the DSS. Further, general recommendation of how to apply fertilizers for a particular crop and also an additional recommendation based on soil pH value is provided (Fig. 3, 4 and 5).

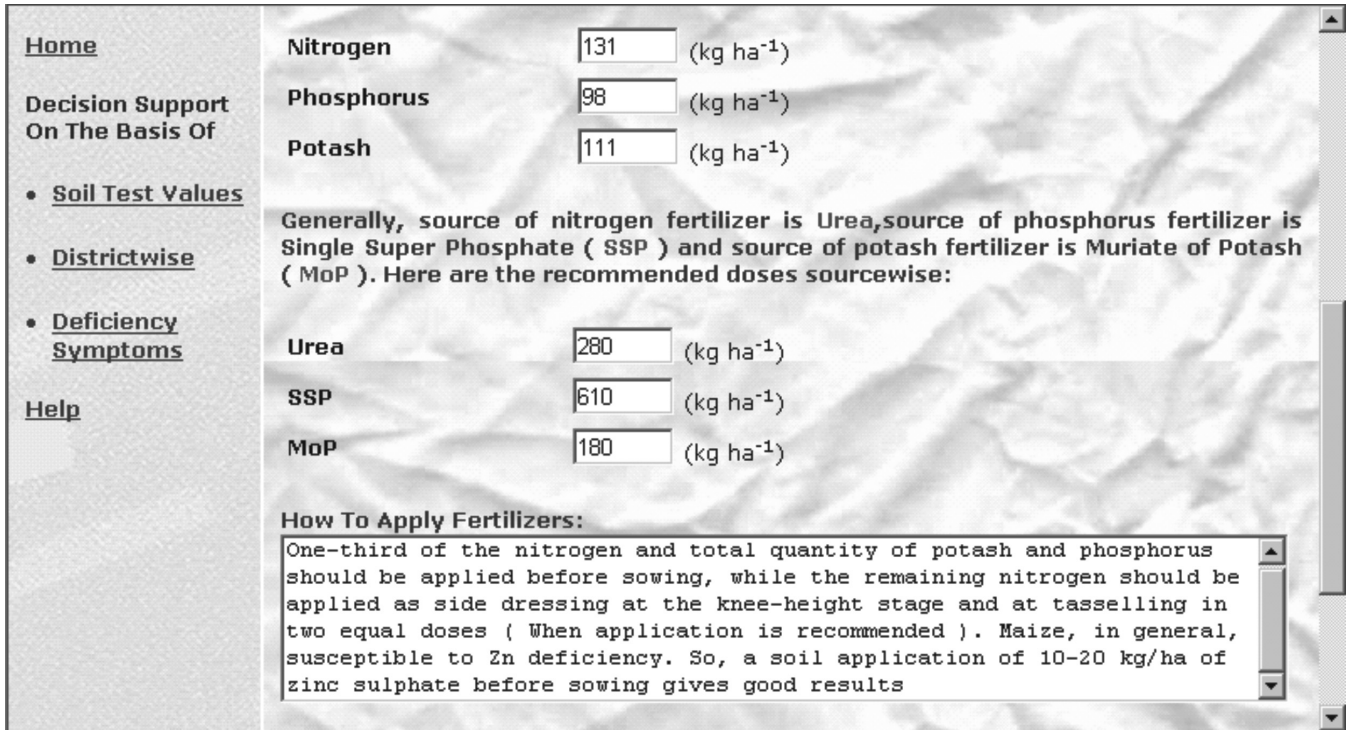

Fig. 4. Source of fertilizer applied

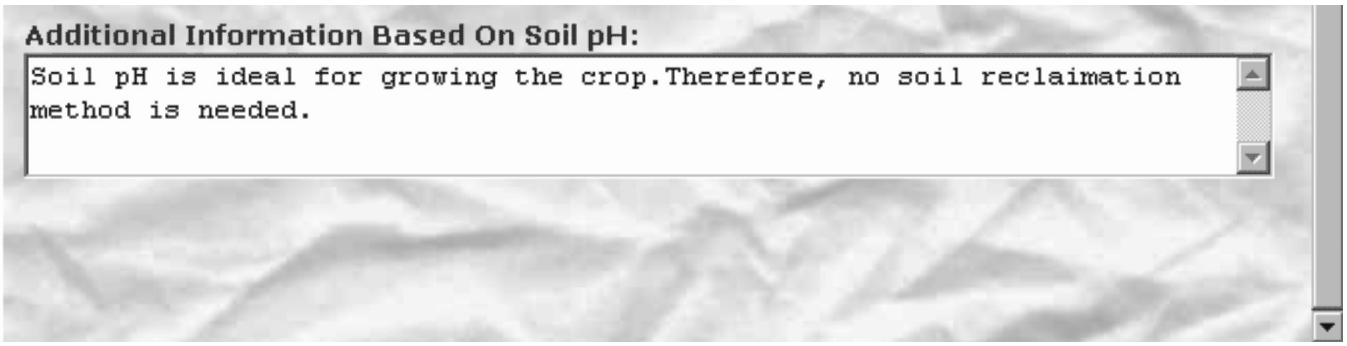

Fig. 5. Effect of pH value

(b) **Subsystem based on location such as zone or district:** This module will take input as the location of the farm in terms of zone or district and targeted yield and rest other values like, available nitrogen, phosphorus, potassium and the soil pH are taken from data base, where standard values for

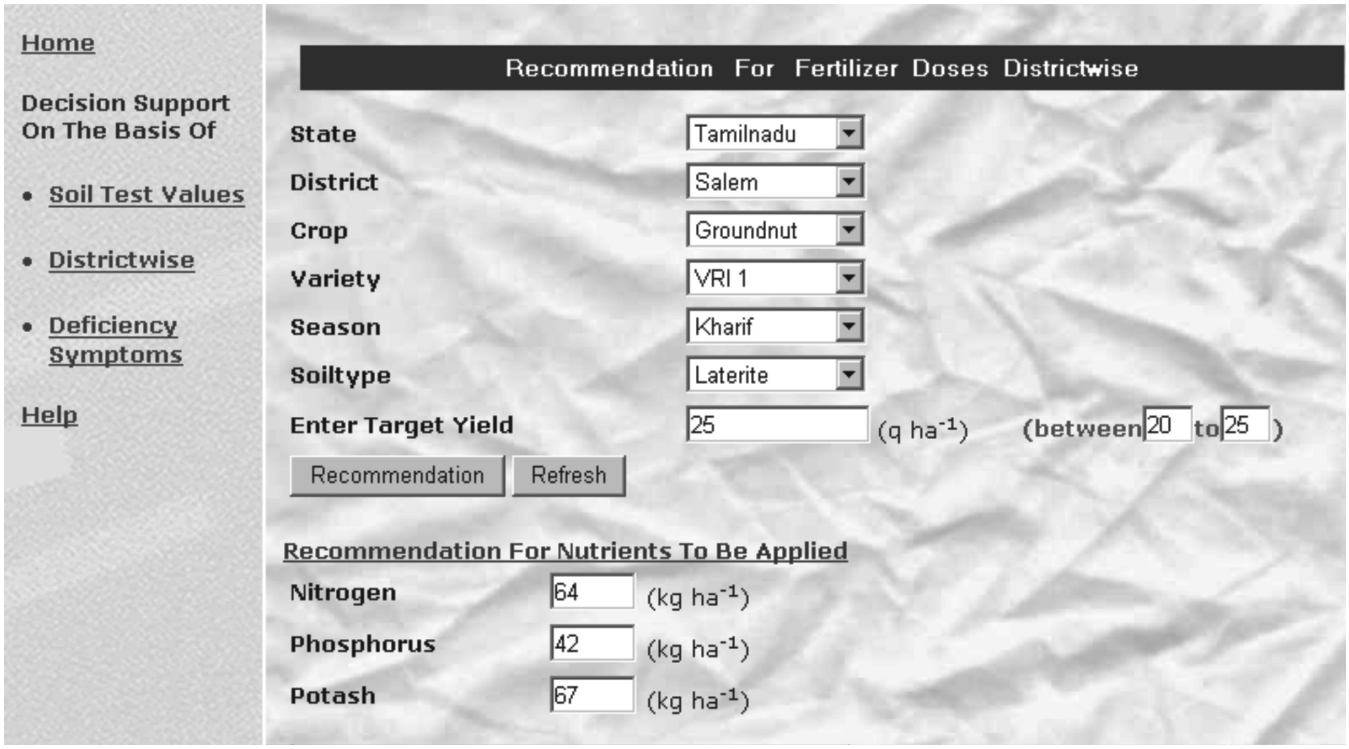

Fig. 6. Information about the location of the farm

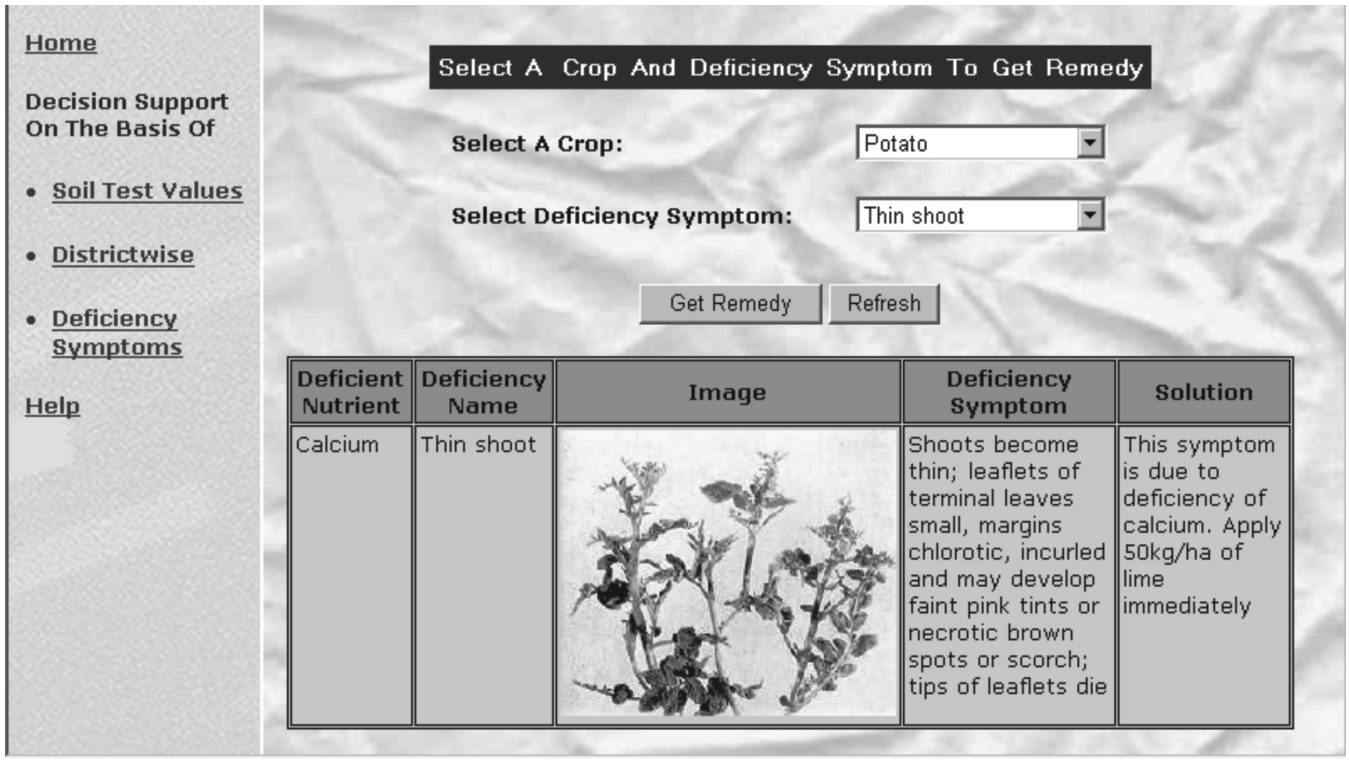

Fig. 7. Deficiency symptoms for a crop

particular zone or district are stored and decision is provided in the same way as in the previous module (Fig. 6).

(c) **Subsystem based on deficiency symptoms:** Proper fertility management requires the ability to recognize deficiency symptoms, either to correct them early in the growing season or to prevent them in subsequent parts of the season. In this module, user can get information for a particular crop on the basis of deficiency symptom observed by him, which he tallies with the images provided in the system (Fig. 7).

4. CONCLUSION

DSSNMC has been developed for providing decision support to the farmers, students, research workers, extension workers and others for nutrient management in crops. It can be implemented as network-based with a server. Currently, there are provisions for rice, rapeseed, wheat, groundnut, maize and potato crops in the system. But it will work for any crop. The system is menu driven and user-friendly. Hopefully, the use of this system will provide intellectual support to farmers in proper application of fertilizers to their crops.

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