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Web based DSS for lime recommendation in acidic soils

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ABSTRACT
The adverse effects of soil acidity can be solved either by addition of lime to counteracts the anomalies of such soils or to manipulate the agricultural practices to obtain optimum crops production. This decision support system allows users to obtain lime recommendation based on soil test results, to calculate the amount of lime required to bring the soil pH to a target pH of 6.5 which is suitable for cultivation of major crops in acidic soils of the region. To use the program, users should enter both pH and Soil clay content/buffer index for an accurate lime recommendation. Then, the system will automatically calculate the quantity of lime required to bring the soil to a target pH of 6.5 and will provide immediate solution in the respective column.

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INTRODUCTION

In India most of the acid regions soils are sedentary and are found in hilly terrains. Generally these are common in on hill tops, hill slopes, terraced and unterraced uplands, medium lands or valley floors (Mandal, 1996). The acid soils in India occupies approximately 100 million ha of the geographical area. Such type of problematic soils in India are mainly concentrated in north eastern region and western Ghats with sporadic distribution in Jharkhand, Himachal Pradesh, Orissa, Orissa, West Bengal, Chhatisgarh, etc. As such almost 84, 77, 76, 60, 57 and 47 percent soils of Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Sikkim and Tripura respectively have the soil pH below 5.5 and are considered strongly acidic (Panda, 1998). The toxicity of soil Al has been recognized one of the important factors limiting the productivity of crops on acid soils having pH below 5.5 in humid north eastern hills (NEH) region of India (Patiram, 2002). Acid soil infertility is a syndrome of problems that affect plant growth in soils with low pH. Soil acidification is a major soil degradation issue in many parts of North eastern region of India. It is often an insidious soil degradation process, developing slowly although indicators such as falling yields, leaf discoloration in susceptible plants and lack of response to fertilizers can indicate that soil pH is falling to critical levels. If it is not corrected, acidification can continue until irreparable damage takes place in the soil. The vast areas are under slash and burn cultivation and these ancient and highly weathered soils and current systems of agricultural land use are particularly vulnerable to this process. Soils under jhums of North –Eastern Region are becoming increasingly infertile and acidic. Future changes in critical soil acidity can lead to catastrophic effect in soil quality and there is an urgent need to establish an accurate baseline for measuring future changes. Knowledge of soils/land management practices is needed to interpret soil acidity trends and to determine the effect of changes in management practice on the rate of soil acidification. The adverse effects of soil acidity can be solved either by addition of lime to counteracts the anomalies of such soils or to manipulate the agricultural practices to obtain optimum crops production. The liming of acid soils periodically, replenishes the calcium and magnesium, and neutralizes the soil acidity and other toxic nutrients to plants. The application of agricultural liming materials (referred to commonly as lime) to acidic soils, increases soil pH and decreases soil acidity and frequently alleviates the problems of soil infertility stresses without addition of harmful elements. Agricultural liming materials contain compounds of carbonates, hydroxides, or oxides of calcium and magnesium. Liming materials include limestone, burned lime, marl, oyster shells, slag, cement plant flue dust, mining tailings, sugarcane press mud, wood ashes, and paper mill lime sludge. It can be categorized into

carbonates, oxides, hydroxides, and by-product materials. This decision support system allows users to obtain lime recommendation based on soil test results, to calculate the amount of lime required to bring the soil pH to a target pH of 6.5 which is suitable for cultivation of major crops in acidic soils of the region. To use the program, users should enter both pH and Soil clay content/buffer index for an accurate lime recommendation. Then, the system will automatically calculate the quantity of lime required to bring the soil to a target pH of 6.5 and will provide immediate solution in the respective column.

MATERIALS AND METHODS

The overall computerized system is user friendly and interactive and has been designed in such a manner that even a person with limited computer skills can handle it easily. The total software size is however in several MBS but can easily be started in a PC. The main user interface is provided in the form of popup Menu-Bar with Menu options viz. Mizoram at a glance, Crop cafeteria of Mizoram, Jhums of Mizoram, Soils and land uses, Soil survey and sampling, Soil fertility management etc as shown in Fig. Each of these menu options has a few Sub-menu options which when clicked will open a certain form to perform certain task. The variety list for a particular main menu is entered through sub menu options that is available to the user by clicking. The programme has been fully developed using web technologies viz. Hypertext Markup Language (HTML) and ASP (Active Server Pages) to facilitate on user with little computer awareness. The data base at back end is designed using Excel spread sheets and reports are generated as web pages. The system is described and the extent to which it has met its objectives is discussed in length with emphasis on the requirements of the end user. This can be useful for primary stakeholders, researchers, planners and others as it will give desired informations at one platform regarding various aspects of farming in Mizoram. Some of the web pages like lime recommendation has the potential to be made online and this can be very first of its kind effort in India. A computer programme written in HTML loads which aids –

a. Maintaining database of soil, water and plant test results.
b. Interpretation of soil, water test results and
c. Providing the recommendations based on results.

Various sub-menu in the programme enables the users select the appropriate options for the recommendations they are interested in. The output of the results can be seen either on the monitor or can be taken as a hard copy. The programme is also designed to provide the output in text format so that user can make use of the data in any of the work processor. The guidelines followed in majority of the soil testing laboratories in India for interpreting pH, OC , avail. NPK and micronutrients have been used. This programme will help the user in

a. maintaining the data base of the results of numerous soil and water samples .
b. obtain quick and accurate interpretation of soil and water test results
c. necessary nutrients recommendations
d. using the database so maintained for developing soil test summaries for a particular nutrients and for a particular village or district and also for monitoring fertility status over a period.

RESULTS AND DISCUSSION

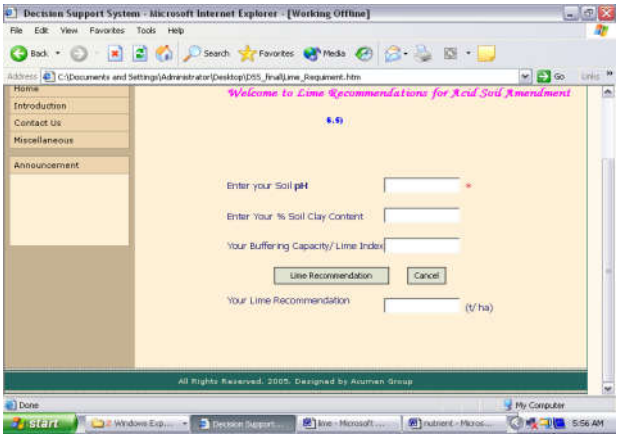

Fig.1. Screenshot of the lime module

Any strategy for optimum land use in the North Eastern States is usually confronted with various constraints. There are different types of problem lands where the constraints for optimum production are either unfavourable physico-chemical properties of the soil or some inherent land features and/or

environmental conditions limiting optimum growth of crops. As such the productivity of these lands goes down to a considerable extent. Soil acidity is one such limiting factor affecting adversely crop production to a considerable extent mainly in high rainfall and light texture conditions over extensive areas of North Eastern states.

Soil acidity management

This part of the program allows users to enter soil test results and then it generates lime recommendations for major crops grown in Mizoram at the target pH of 6.5.To use the program, users should entered both pH and Soil clay.

To solve the problems related to acid soils, their management and provide immediate information to solve the problem of the user an interactive web-based computer program has been developed to provide assistance on making decisions related to acidic soils and their management.

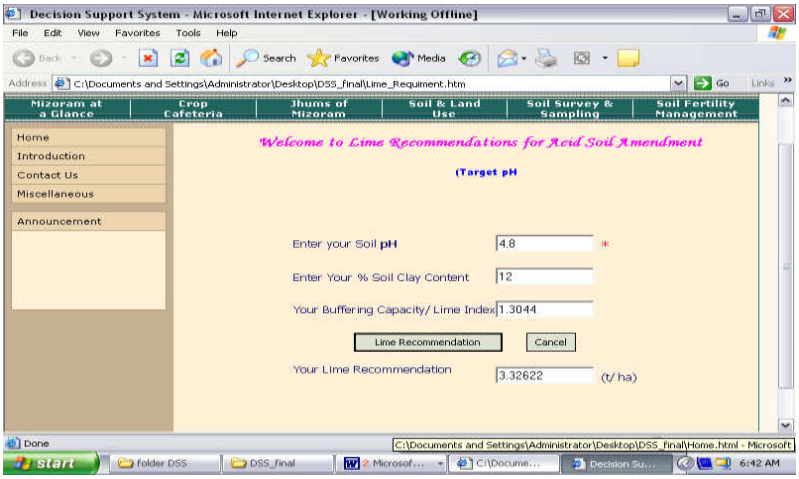

Fig.2. How the lime module works

The Buffer pH (BpH) has a unique feature in that it automatically considers the different buffering capacities of soil textures. Example of 2 soils, one sand, one clay both with a pH of 5.5 can have different buffer pH values. The sand may have a BpH of 6.9 and the clay a BpH of 6.3. According to the table in Pub 296 the recommended rate of lime to achieve a target pH of 6.5 would be 2 and 5 tonnes per ha. The clay soil has a higher buffering capacity, caused by the higher exchange capacity, which holds more H and requires a greater amount of lime to raise the pH from 5.5 to 6.5. Whereas the sandy soil with a lower buffering capacity, and a lower exchange capacity requires less lime to move the pH from 5.5 to 6.5.

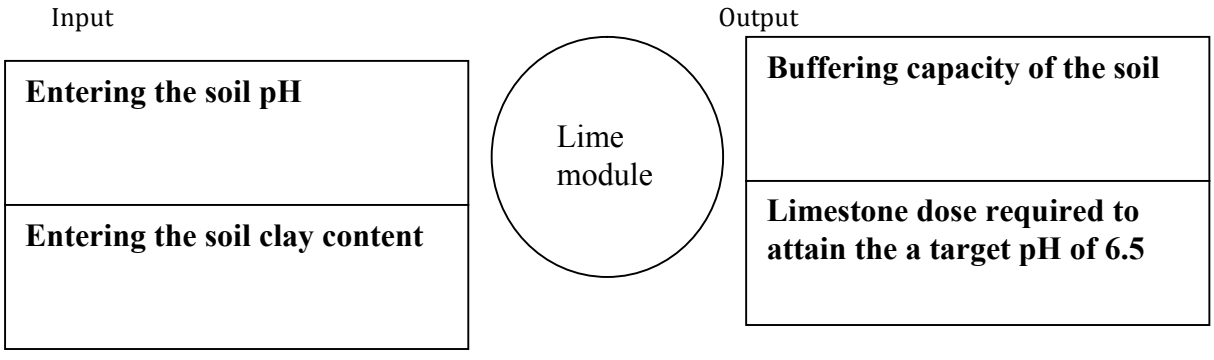

Fig. 1 Flow diagram of Input –output relationship for lime module

It is hoped that the outcome of the programme will go long way in addressing one of the vital issue of this part of India and acid soils as a whole.

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