© 2018 IJSRST | Volume 5 | Issue 3 | Print ISSN: 2395-6011 | Online ISSN: 2395-602X
Themed Section: Science and Technology

# Determination of Soil PH and Development of a Web Application for Crop Selection

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## ABSTRACT

This paper discusses the determination of soil pH and development of a web application for the real time use. The pH values of the soil sample was determined experimentally and theoretically. It includes the design and development of a web-application that will display the most suitable crops that can be cultivated in the specific region, based on the input values of pH, rainfall, temperature and soil type prevalent in that particular area. This project is developed with the idea of helping farmers choose the most optimum crops to cultivate in order to maximize the quality of their yield.

**Keywords:** pH; glass membrane electrode; HTML, CSS, PHP

## I. INTRODUCTION

pH was originally acronym of French clause 'pouvoirhydrogene' which can be translated into English as 'power of hydrogen' or 'potential of hydrogen'. pH is used to quantify acidic or alkaline nature of a chemical which is measured in terms of H+ ions concentration. pH is a scale of acidity from 0 to 14. Substances that are neither acidic nor basic have a pH of 7 and are called as neutral solutions. More acidic solutions have lower pH i.e. less than 7.More basic or alkaline solutions have higher pH i.e. greater than 7. pH is a measure of concentration of protons(H+) in the solution S.P.L. Sorenson introduced this concept in 1909.Letter p indicates a German word potenz ,which means power or concentration. Letter H indicates hydrogen ion (H+).For calculating pH the formula is given as pH = -log10[H+]

[H+] indicates concentration of H+ ions(also can be written as $[H_3O]+$,the equal concentration of hydronium ions),measured in moles per litre (also known as molarity) [1].Alkaline substances have concentration of hydroxide ions(OH-) instead of hydrogen ions. Great deals of agricultural losses are incurred every year in our country due to a variety of reasons by people who depend on agriculture as a livelihood. A number of reasons are: lack of awareness about the properties of the soil and land that they intend to cultivate on, unseasonal and irregular rains, etc. Even if they do know about the pH, rainfall, temperature and soil properties, they are unable to identify which crops would be the most suitable to grow within the constraints of their parameter values. Information regarding this, even though available, is not readily available to farmers in an easy manner.

Our project has been developed in an effort to ease the process of selecting the right crop to cultivate for farmers. Data collected from research and other authorized sources about crops and their optimum parameter values was entered into a database. An easy-to-use web page has been developed for the user.

Output will be displayed after performing manipulative and computational operations on the collected input data.

## IMPORTANCE OF SOIL pH

Wide range of ph in solution culture can be tolerated by most of the plants, but they tolerate a wide range of acidity in the soil. Because of acidity of soil changes, the solubility of concentration of metal ion also changes. Plant growth gets affected by the varying concentration of metal ion in solution rather than the acidity itself. Many soil minerals dissolve and increase the concentration of metal ions to toxic levels under acidic conditions. The primary toxic level is aluminum is due to high levels of manganese and iron can also inhibit the growth of plants under the above conditions. The nutrients phosphorous, molybdenum, magnesium and calcium are less than the required amount in acidic soils.

Nutrient deficiencies occur in the alkaline conditions of the soil due to decrease in mineral solubility. Deficiencies in iron, manganese, copper, zinc and boron restrict the growth of plants. Due to less availability of phosphorus in alkaline soils it iinhibits the uptake of potassium and magnesium [2].

pH VALUES FOR SOME COMMON CROPS:-

**Table 1**

| Sl. No | Crop | pH range | Optimum temperature range[c ] | Average rainfall [cm] | Type of soil |
|---|---|---|---|---|---|
| 1 | Cotton | 5.5-6.5 | 18-30 | 60-120 | Deep black and alluvial soil |
| 2 | Jute | 5.0-7.4 | 24-37 | 125-200 | Sandy , alluvial and Clayey loam soil |
| 3 | Ragi | 4.5-8.0 | 20-30 | 50-100 | Alluvial and red soil |
| 4 | Tea | 4.5-5.5 | 13-35 | 150-250 | Sandy loam and laterite soil |
| 5 | Coffee | 4.5-5.5 | 15-28 | 125-200 | Loamy, red and laterite soil |
| 6 | Rubber | 5.0-6.0 | 21-35 | 200-400 | Loamy and laterite soil |
| 7 | Rice | 5.5-6.5 | 16-32 | 150-200 | Clayey, black lava soil |
| 8 | Tobacco | 5.5-6.5 | 75-80 | 50-125 | Sandy loam and alluvial soil |
| 9 | Sesame | 5.5-8.0 | 21-23 | 45-50 | Loamy and black soil |
| 10 | Wheat | 6.0-7.0 | 15-26 | 25-100 | Loamy and alluvial soil |

pH VALUES FOR SOME SOIL SAMPLES:-

**Table 2**

| Crop | Scientific pH | Determined pH[laboratory] | |
|---|---|---|---|
| | | With silt | Without silt |
| Beans | 6.0-7.5 | 7.1-7.5 | 7.1-7.6 |
| Bitter gourd | 5.5-6.7 | 5.1-7.3 | 5.3-7.5 |
| Banana | 5.5-6.5 | 7.6-7.7 | 7.9-8.0 |
| Marie gold | 5.5-7.5 | 6.7-7.6 | 7.0-7.9 |
| Maize | 5.5-7.0 | 6.8-7.7 | 6.9-7.8 |
| ChowCh | 6.5-7.5 | 7.0-7.3 | 7.4-7.6 |

**1.RICE:**

Rice is a food grain that contains a number of vitamins and minerals that are extremely healthy for us. Rice is a wonderful and versatile grain that complements practically any food. And there are more than 8000 different types of rice categorized by size and by the method used to process. Rice cultivation is best suited on the alluvial soil or on the fertile river basins, mixed soil or loamy soil or clayey soil. It is grown well in black lava soil. The soil of pH 5.5 -6.5 is suitable for the growth of rice [3].

**2.GROUND NUT:**

The peanut also known as the ground nut and taxonomically classified as ARACHIS HYPOGARA, is a legume crop grown mainly for its edible seeds. It is widely classified grown in tropics and subtropics, bring important to both small and large commercial producers. It is classified as both as legume and grain because of its high oil content, an oil crop [4].

For growing peanuts in containers fertile and light soil is required which is neutral in pH and well drained. Groundnuts can be well grown in loamy soil, black soil and red soil. It requires a pH range of 6.0-6.5 for good yield.

**3.WHEAT**

Wheat is a cereal grain of species triticum. People eat it most often in the form of bread. Wheat is the best source of vegetable protein content than other major cereals. Wheat cultivation is best suited in the soil with a clay loam or loam texture, good structure , moderate water holding capacity and heavy soil with good drainage. It requires an optimum pH range of 6.0-7.0. Wheat grows well even in alluvial soil.

**4.CHOW CHOW**

Scientific name of chow chow is sechiumedule. It is also called the vegetable pear. It is mostly handled like summer squash and generally cooked to retain in rispflavor. It is a rich in vitamin C and perfect cooling vegetable. Chow chow is one of the edible perennial plants belonging to the gourd family cucurbitaceae, along the melons, cucumbers and squash. Chow chow is also known as chayote, summer squash etc.[5] The soil with good drainage facility and preserving the soil moisture is suitable for chow chow crop. Chow chow cultivation is best well drained loamy soil and alluvial soil. Chow chow crop is slightly tolerant to acidic soil.The soil pH range is between 5.5-6.5.

**5.MARIGOLD:-**

Marigold is one of the most commonly used flowers for garden decoration. Itis also extensively used as loose flowers for making garlands for social and functions. It is adapted to different types of soil. Sandy loam soil with pH 5.6-6.5 is ideal for its cultivation. Acidic and alkaline soil is not suitable for cultivation. Marigold takes about 2months to complete vegetative growth and later enters into reproductive phase. Sufficient amount of moisture in soil is required at vegetative and flowering period [6].

**6.BANANA:-**

Banana is ranked as the second most important fruit crop in India. Its aaffordability, availability, varietal range, nutrition, taste and medicinal values makes it favorite fruit for all kindsof people. Its export ppotential is also good. The soil with good drainage, ,moisture and adequate fertility is best suited . Deep rich loamy or clayey loam soil is also essential. pHrangebetween 6.0-7.5is necessary.

### 7.BITTER GOURD:-

Bitter gourd can also be called as bitter melon which is a unique vegetable fruit that can be used as medicine and food. Bitter gourd grows in wide range of soils. For optimum growth and production it prefers soils that are sandy loam with good drainage and rich in organic matter. Alluvial soil is suitable for the growth of bitter gourd. A soil with pH value ranging from 6.0-7.5 is favorable for bitter gourd cultivation.

### 8. COTTON:-

Cotton is one of the most important cash crop in India and plays a prominent role in agricultural and industrial economy of the country. It is the basic raw material for the cotton textile industry. Deep well drained soils with good nutrient content and deep black alluvial soil is suitable for cultivation of cotton. Soil with pH range of 5.5-6.5 is favourable for growth of cotton crop.

### 9. BEANS:-

Beans belongs to aflowering plant family fabaceae, which is a seed of one of the several genera. Pole beans and bush beans more commonly called green beans are the major types of beans. Beans need a sunny well drained area rich in organic matter for its cultivation. Soggy, cold soil will cause the seeds to rot. Beans grow well in sandy soil, loamy soil and alluvial soil. Beans likes soils which are slightly acidic pH range around 6.0-6.5 gives better yield.

## DEVELOPMENT OF FRONT-END WEB PAGE:

HTML and CSS codes have been used in our project to aestheticize and structure our web page in a user-friendly manner. A header provides information about all the sections present and a pleasant background has been added to enhance user experience. Form has been used to collect user input with appropriate headings to guide with what the expected input is.

## DEVELOPMENT OF BACK-END DATABASE:

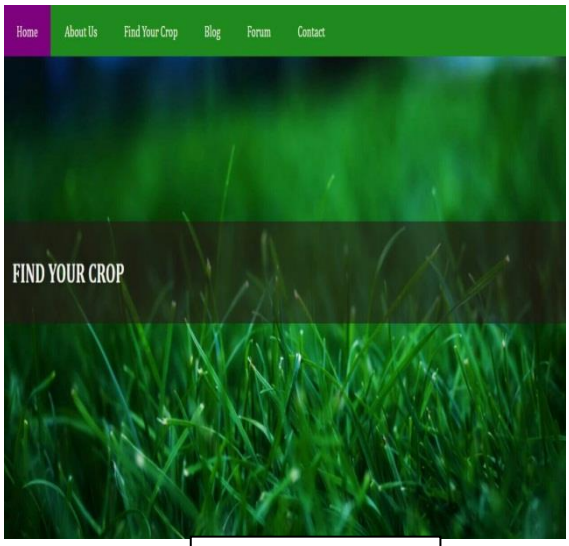
SQL and PHP have been used to handle the server side scripting and back-end database handling in our project. XAMPP software was used to establish a connection with the Apache web-server and enable working with mySQL. A database named “crops” was created and a table named “cropsinfo” was created to store details of crops collected under 9 columns, namely: SERIAL, NAME, pHLOW, pHHIGH, RAINLOW, RAINHIGH, TEMPLOW, TEMPHIGH and SOIL. Between the LOW and HIGH values of each parameter lies the range of those parameters where the crop is suitable to be cultivated. Individual records of crops were manually inserted into the table using SQL queries after establishing a connection with the database via a php-sql file. Crops that can be cultivated in more than one type of soil were entered each time with individual soil value to ease the extraction later.

## EXTRACTING RECORDS FROM DATABASE BASED ON USER INPUT VALUES:

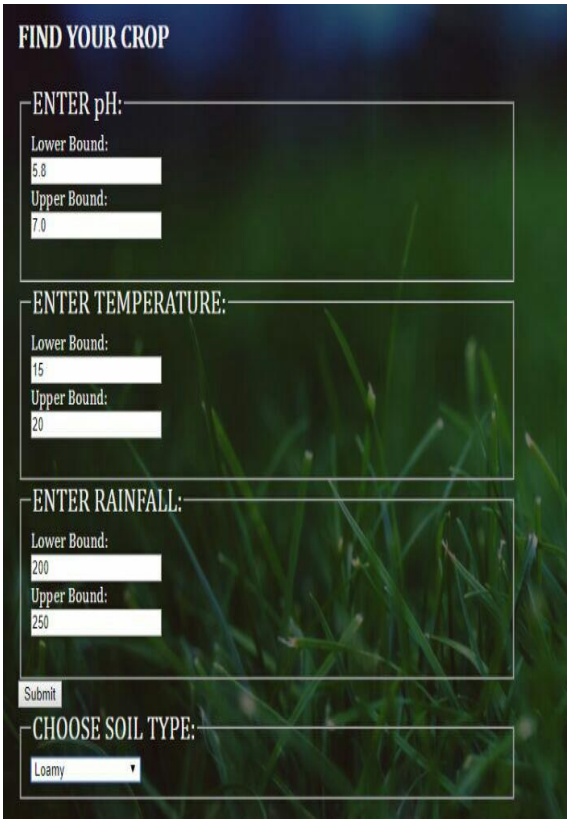
The POST method offered by PHP is used to collect information input by the user into PHP variables for further manipulation in a separate PHP file. The query used for extracting the correct crop for displaying is:

$query = "SELECT * FROM cropsinfo WHERE soil = '$sol' AND phlow<=$phl AND phhigh>=$phh AND templow<=$templ AND temphigh>=$temph AND rainlow<=$rainl AND rainhigh>=$rainh";, where $sol, $phl, $phh, $templ, $temph, $rainl, $rainh are PHP

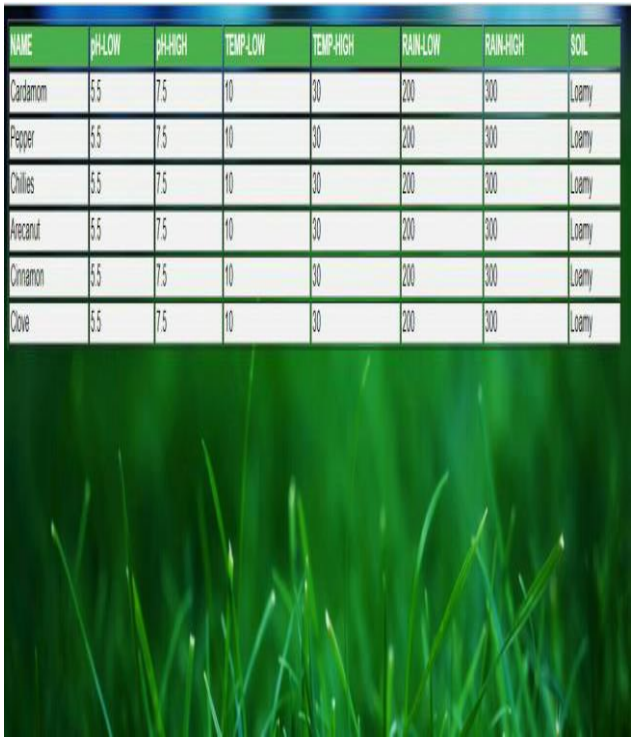
variables where user input values have been stored using the POST method. **Photographs:**




FRONT PAGE

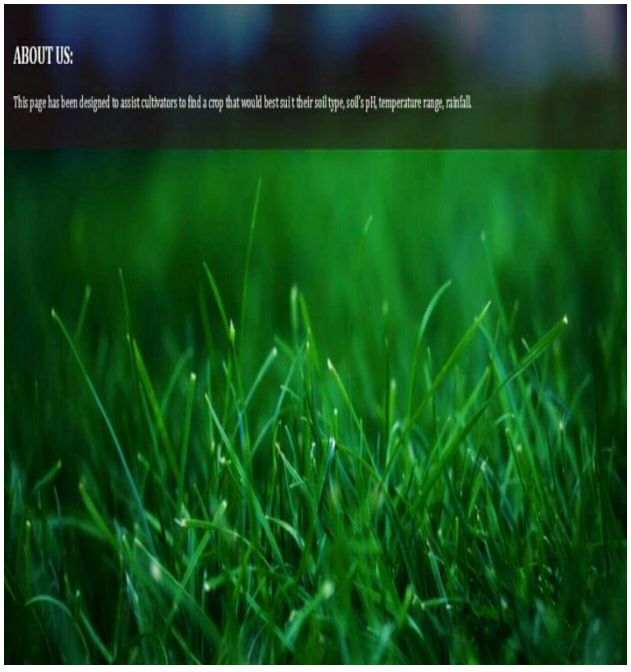


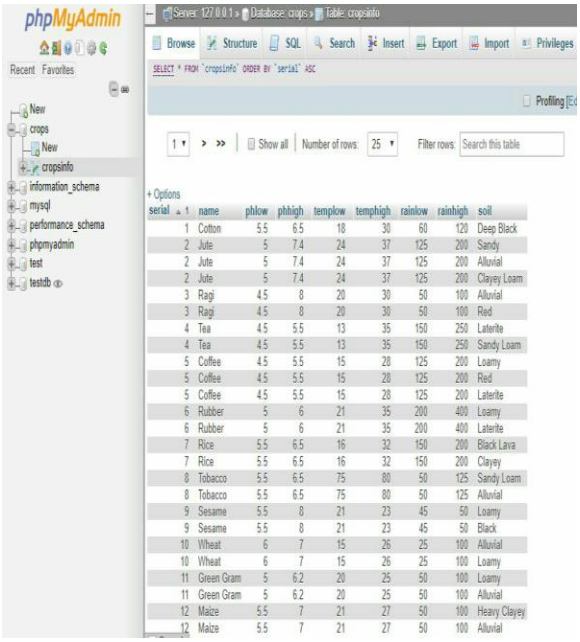

ENTERING PARAMETER VALUES

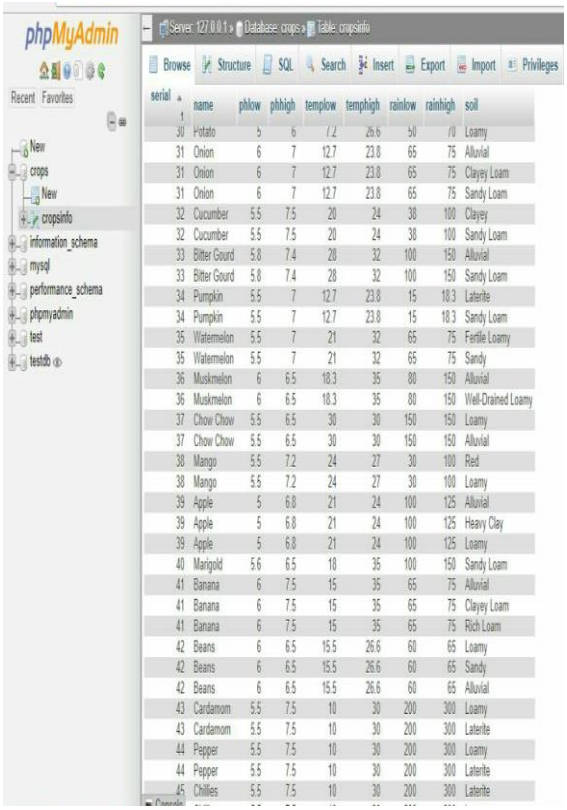


| NAME | pH-LOW | pH-HIGH | TEMP-LOW | TEMP-HIGH | RAIN-LOW | RAIN-HIGH | SOIL |
|---|---|---|---|---|---|---|---|
| Cardamom | 5.5 | 7.5 | 10 | 30 | 200 | 300 | Loamy |
| Pepper | 5.5 | 7.5 | 10 | 30 | 200 | 300 | Loamy |
| Chillies | 5.5 | 7.5 | 10 | 30 | 200 | 300 | Loamy |
| Arecanut | 5.5 | 7.5 | 10 | 30 | 200 | 300 | Loamy |
| Cinnamon | 5.5 | 7.5 | 10 | 30 | 200 | 300 | Loamy |
| Clove | 5.5 | 7.5 | 10 | 30 | 200 | 300 | Loamy |

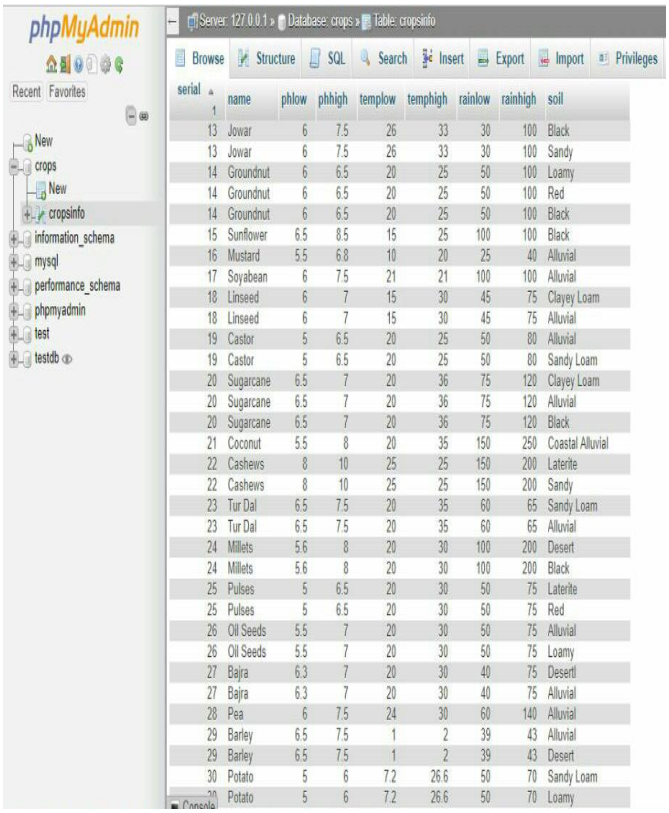
OUTPUT DISPLAYING CROPS THAT HAVE PARAMETER VALUES WITHIN THE RANGE THAT WAS GIVEN AS INPUT

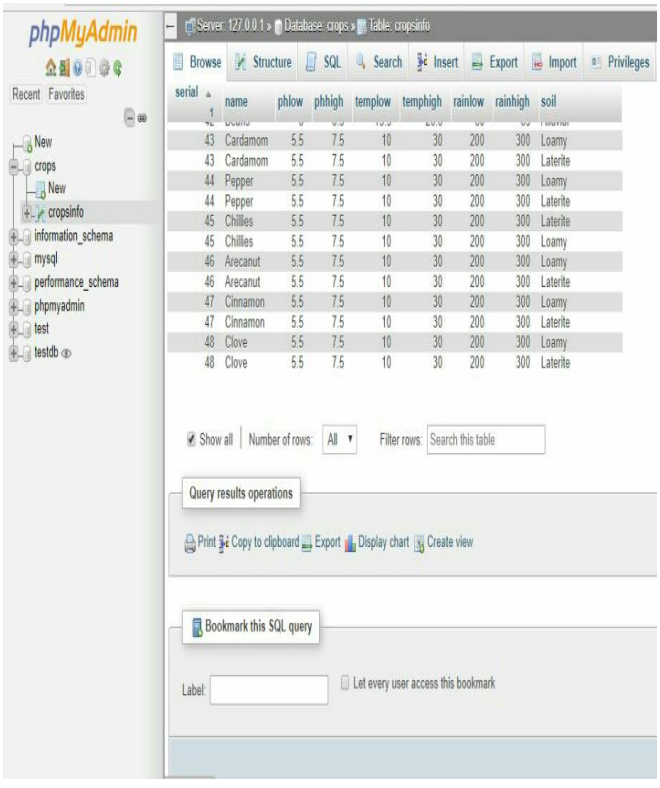





IMAGES OF




IMAGES OF DATABASE

## II. CONCLUSION

We have determined pH of the soil sample by using a glass membrane electrode. With the help of pH values a web application is developed for the real time application to the end users. This web application is useful for selecting a particular crop for cultivation depending upon the pH of the soil sample. Our web application will also provide information based on values of rainfall, temperature and soil type which helps to decide the particular crop for cultivation in the field.

## III. ACKNOWLEDGEMENT

The authors would like to thank Dr J Suryaprasad, Principal, PESIT-BSC for his encouragement during the course of this project work.

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