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Research Article

Study of Soil Samples and Pathogens from Two Cucurbita Plantations in Goa

Sawaiker Ranjita[1]*, Sangodkar Pratiksha[2], Gaude Sneha[2], Gawade Rakshanda[2] and Phadke Jidnyasa[2]

[1]Associate Professor, Department of Botany, P.E. S's R. S.N College of Arts and Science Farmagudi Ponda, Goa, India

[2]B.Sc. Students of Department of Botany, P.E. S's R. S.N College of Arts and Science Farmagudi Ponda, Goa, India

***Corresponding Author:** Sawaiker Ranjita, Associate Professor, Department of Botany, P.E. S's R. S.N College of Arts and Science Farmagudi Ponda, Goa, India.

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Abstract

Fertile soil is the most important resource for the entire living world. Apart from providing a solid substratum, soil provides most of necessities to mankind through the plant and animal communities which develop on it. Soil quality protection is a challenging issue for the use of resources in a sustainable way as it is a prime factor for land use, economic development, thereby maintaining soil health. Mankind cannot survive the depletion of this thin crust of loose material. Lot of agricultural activities is dependent on the type of soil. Cucurbits are vegetable crops belonging to family Cucurbitaceae, which primarily comprised species consumed as food worldwide. The family consists of about 118 genera and 825 species. The Present study was carried out by selecting two study sites where Cucurbits are cultivated extensively viz., Sacorda and Farmagudi area in the state of Goa. Cucurbita plantation is the first priority source of income for the farmers of both Farmagudi and Sacorda. The study aimed to understand variations in physico chemical parameters of soil samples from two cucurbita plantations viz., Sacorda and Farmagudi area from Goa where cucurbits are cultivated extensively and to know the type pathogens attacking them.

Study revealed that the soil samples collected from Farmagudi plantation area showed more variations in physico chemical parameters as well as higher concentration of potassium, electrical conductivity, organic carbon as well as the phosphorus as compared to Scaorda plantation area except for pH which was higher at Sacorda. Cucurbits grown in these areas were affected by aphids, belly rot lesions were caused by fungus *Rhizoctonia*. High degree of infection was recorded at Sacorda as compared to Farmagudi plantation. This reduced the yield of cucurbits in this area. Mining activities in surrounding areas may be also responsible for reducing the soil fertility and in turn production at Sacorda.

Fertile soil in Farmagudi area and lower degree of infection resulted in more yield at Farmagudi area.

Keywords: Cucurbits; Nutrients; Batrocera cucurbitae; Rhizoctonia; Belly Rot; Aphid

Introduction

Soil is the most important component of any landscape [1]. Soil may be defined as a thin layer of earth's crust which serves as medium for growth of plants. It is also the unconsolidated mineral matter which is subjected to environmental factors like parent material, climate, organisms and topography acting over a period of time [2]. Fertile soil is the most important resource for entire living world. Apart from providing solid substratum, it provides necessities that favor growth of plant and animal communities which develop on it. The prosperity and well-being of a nation depend largely on fertile land and productive soils [3]. Soils can effectively remove impurities, kill pathogens, and degrade contaminants. It provides readily available nutrients to plants and animals by converting dead organic matter into various nutrient forms (https://www.quora.com/why-is-soil-regarded-as-our-most-important-natural-resource). Soil can absorb and hold water like a sponge. In doing so, it regulates water drainage and reduces the risk of flooding. Through carbon sequestration, the soil also plays a central role in the climate system [4]. Soil quality protection is a challenging issue for the use of resources in a sustainable way as it is a prime factor for land use, economic development, thereby maintaining soil health [1].

India is world's largest producer of several fruits, agriculture-based textile raw materials, roots and tuber crops, pulses, sugarcane and numerous vegetables. Cucurbits are vegetable crops belonging to family Cucurbitaceae, which are consumed as food worldwide. The family consists of about 118 genera and 825 species. There is remarkable genetic diversity within the family, and the range of adaptation for cucurbit species includes tropical and subtropical regions, arid deserts, and temperate regions. A number of cucurbit vegetables are exported from India [5]. It forms largest group of summer vegetable crops. These include cucumber, muskmelon, watermelon, tinda, bottle gourd, bitter gourd, pumpkin, ridge gourd, squashes, parwal and snake gourd. Almost all the cucurbits have considerable economic value [6].

Tourism promoters and Government of Goa have attempted in recent years to advertise Goa as one of the greenest regions on the planet. Much of this greenery is manmade, created through hard work of villagers, their agriculture and fruit gardens.

Every year, thousands of farmers transform Goa's fields into a lush green carpet. Along with paddy, coconut, cashew, lot of cucurbits is cultivated on the hill slopes and in the plains during rainy and summer season.

When the literature pertaining to studies on cucurbita plantations in Goa was carried out, it was scarce. In lacuna of this, it was decided to carry out present investigation with following aims and objectives.

Aims and Objectives

- To study the monthly variations in physiochemical parameters of soil in selected study sites.
- To know about the variety of cucurbits cultivated in monsoon season in the study sites.
- To enlist the diseases of cucurbits in the study sites.

Methodology

Goa, the smallest state of India, is located on the western coast of the Indian peninsula. The location of Goa is such that it shares its borders with Maharashtra towards the north and Karnataka towards the south. The Arabian Sea lies to its west. The geographical location of Goa is between 15°48'00" North to the 14°53'54" North latitude and 74°20'13'' East to the 73°40'33'' East longitudes.

Goa experience maritime climate and this state is often referred to as a 'tourist's paradise' (https://www.mapsofindia.com/maps/goa/goalocation).

The Present study was carried out by selecting two study sites located 25 km away from each other and where Cucurbits are cultivated extensively viz., Sacorda and Farmagudi. Sacorda is a suburb of Dharbandora taluka in South Goa district of Goa state. The geographical location of Sacorda is 15.3841^0 North and 74.1181^0 East (https://en.m.wikipedia.com). The place is famous for ancient Shiva temple. Local people cultivate lot of cucurbits during the monsoon season on the hill slopes of Navemvado (Plate Ia). Farmagudi is a suburb of Ponda taluka in North Goa district of the state. The geographical location of Farmagudi is 15^{0}24' North and 73^{0}59' East (https://en.m.wikipedia.farmagudi.com). The selected study site is in the campus of Goa college of Engineering (Plate Ib).

The soil samples were collected from the cucurbita plantations of Sacorda and Farmagudi area for a period of four months i.e. from August to November 2017 from four different places of the field. The collected soil was mixed carefully to make composite sample and was air dried completely. Nutrients of both the samples were tested by appropriate soil analysis. Six physico- chemical parameters viz., pH, Electrical Conductivity, Temperature, Organic Carbon, Potassium and phosphorous were analyzed on monthly basis.

pH was analyzed using pH meter; Electrical conductivity was measured by using conductivity meter; Temperature was measured using soil thermometer; Organic carbon was analyzed by Colorimetric method; Potassium was analyzed using Flame photometer while Phosphorous was analyzed using Spectrophotometer. The infected parts of the Cucurbita plants and the insects affecting them were collected from study sites during study period.

Result and Discussions

Monthly variations in analyzed parameters of the soil samples from both study sites are depicted in (Table 1 and 2) and (Figures 1 to 6) respectively.

Sacorda Cucurbita Plantation				
Parameters	**Months of study**			
	Aug - 17	**Sep - 17**	**Oct - 17**	**Nov - 17**
pH	5.9	5.7	7.5	7.3
Electrical Conductivity	0.399	0.011	0.298	0.164
Temperature	29	30	29	31
Organic Carbon	2.05	1.34	4.45	4.45
Potassium	509.6	305.7	201.6	221.7
Phosphorous	84	84	25.2	9.5

Table 1: Monthly variations in Physico- chemical parameters at Sacorda Cucurbita Plantation. Legend: Values are average of three readings. EC- (m.mhos/cm); Temp.- (0C); OC - (%); K - (kg/Ha); P- (kg/Ha).

Farmagudi Cucurbita Plantation				
Parameters	**Months of study**			
	Aug - 17	**Sep - 17**	**Oct - 17**	**Nov - 17**
pH	6.1	4.8	6.4	5.3
Electrical Conductivity	1.311	0.063	0.728	0.173
Temperature	30	29	30	32
Organic Carbon	0.79	1.51	3.99	3.86
Potassium	579	752.6	287.8	318
Phosphorous	114.8	162.4	252	392

Table 2: Monthly variations in Physico- chemical parameters at Farmagudi Cucurbita Plantation. Legend: Values are average of three readings. EC- (m.mhos/cm); Temp.- (^{0}C); OC - (%); K - (kg/Ha); P- (kg/Ha).

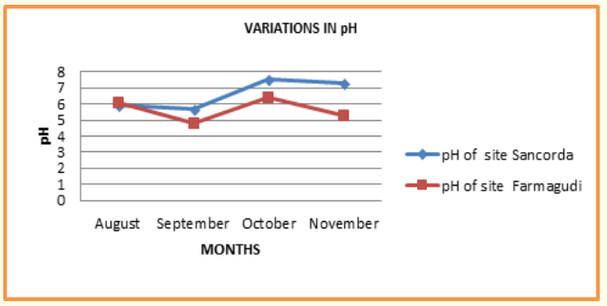

Figure 1: Variations in pH in selected study sites (Aug-Nov 17).

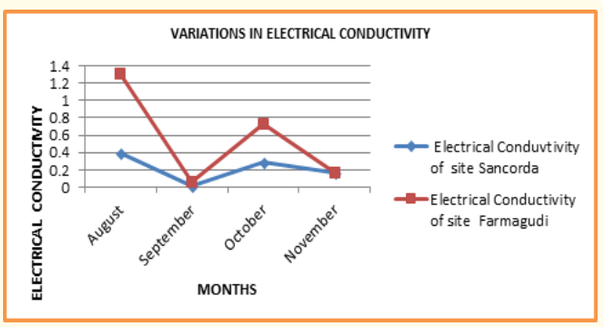

Figure 2: Variations in Electrical conductivity in selected study sites (Aug-Nov 17).

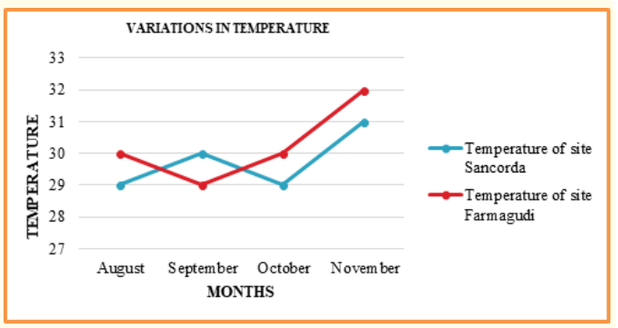

Figure 3: Variations in Temperature in selected study sites (Aug-Nov 17).

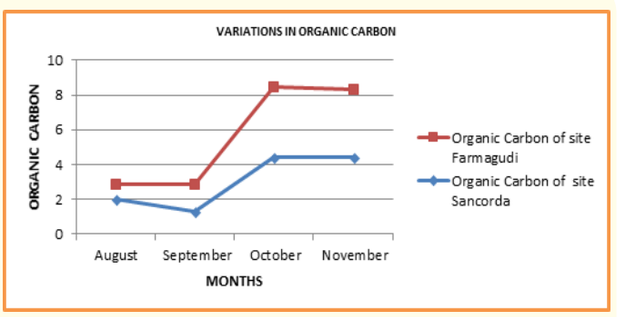

Figure 4: Variations in Organic carbon in selected study sites (Aug-Nov 17).

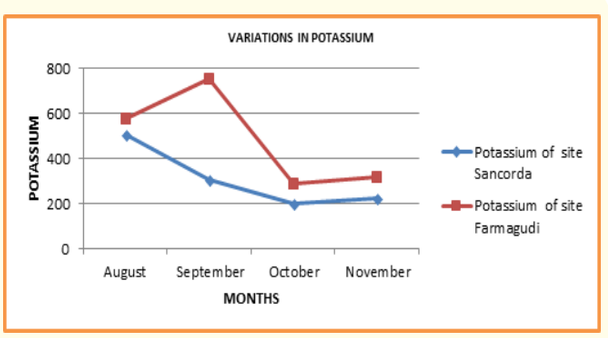

Figure 5: Variations in Potassium in selected study sites (Aug-Nov 17).

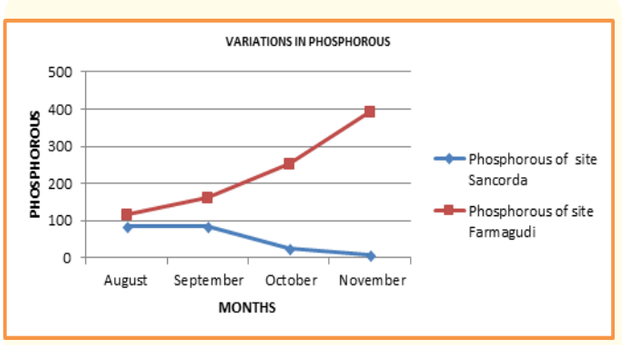

Figure 6: Variations in Phosphorous in selected study sites (Aug-Nov 17).

Varieties of cucurbits grown in both the study sites are shown in plate I while plate II Shows cucurbits affected by diseases.

a. Cucurbita plantation in Sacorda

b. Cucurbita plantation in Farmagudi.

c. Cucumis sativus.

d. Cucumis pepo.

e. Luffa acutangula

f. Momordica charantia.

Plate I: Study sites and Variety of cucurbits grown at both sites.

c. Aphid attack.

d. Protection of ridge gourd.

Plate II: Diseases of Cucurbits

a. Belly rot lesion.

b. Rot of fruit.

The result presented in this chapter of both study sites was compared with each other to understand the dynamics of physico-chemical parameters.

Nutrient analysis is the measurement of nutrients present in the soil. It provides the necessary information to set the target of nutrient application [7]. Maintenance or enhancement of soil quality is a more important criterion for analysis and sustainability of soil ecosystems [8].

The measure of soil pH is an important parameter which helps in identification of the chemical nature of the soil i.e. it expresses the acidity and alkalinity of the soil and is a primary factor in plant growth. The solubility of most nutrients varies in response to pH [9]. pH of Sacorda cucurbita plantation soil varied from 5.7 to 7.5 while at Farmagudi cucurbita plantation it varied between 4.8 to 6.4 showing that the soils were moderately acidic to neutral. Findings of present study were in agreement with Denis., *et al.* [10], who suggested that the "ideal" soil pH is close to neutral, and neutral soils are considered to fall within a range from a slightly acidic pH of 6 to slightly alkaline pH of 7.5. It has been determined that most plant nutrients are optimally available to plants within this pH range. Most of the other nutrients (especially micronutrients) tend to be less available when soil pH is above 7.5, and in fact are optimally available at a slightly acidic pH, e.g. 6.5 to 6.8.

Soil Electrical Conductivity is an important characteristic that can be used for nutrient availability and the soluble salt present in the soil. It is a very reliable test for soil salinity [11]. Electrical conductivity is also a very important property of the soil; it is used to check the quality of the soil. It is a measure of ions present in solution. The EC of a soil solution increases with the increased concentration of ions [8]. Conductivity depends upon the dilution of soil suspension [12]. Electrical conductivity of Sacorda cucurbita plantation soil varied from 0.173 - 0.399 mS/cm while at Farmagudi cucurbita plantation it varied between 0.011 - 1.311 mS/cm, showing that the soil was moderately in a normal range. Desai., *et al*. [13] suggested that when the soil EC is considered to fall within a range from 0.170 - 1.340 mS/cm, it is good for plants. Present results show that Farmagudi cucurbita plantation has minimum value of EC while Sacorda cucurbita plantation has maximum value of conductivity. The electrical conductivity may be ascribed to the leaching of salts to lower horizons [14].

The soil temperature is of great importance as it affects the plant growth directly i.e. all crops practically slow down their growth below the soil temperature of about 90°C. The soil temperature of site one i.e. Sancorda ranged from 29°C to 31°C while at site two i.e. Farmagudi it ranged from 300C to 320C during the study period. Martyn and Miller [15]. Stanghellini., *et al.* [16] and Cohen., *et al.* [17] reported that the temperature ranged between 25 - 35°C is best for the growth of cucurbits.

Organic Carbon is the carbon stored in soil organic matter. The measure of soil organic carbon is an important parameter which helps in identification of many soil characteristics like color, nutrient holding capacity and stability which in turn influence water relations, aeration and workability i.e. organic carbon helps to improve soil stability by micro-organisms by providing a food source for micro-organisms [18]. Organic carbon of Sacorda cucurbita plantation soil varied from 1.34 to 4.45 while at Farmagudi cucurbita plantation it varied between 1.51 to 4.62. Tuffour., *et al* [19]. suggested that the normal organic carbon is considered to fall within a range from 1.30 to 4.60. It has been determined that the most plant nutrients are optimally available to plants within this organic carbon range which has been proved in the present investigation.

Potassium is one of the important elements for the development of the plant. It is involved in many plant metabolism reactions, ranging from lignin and cellulose used for the formation of cellular structural components, for regulation of photosynthesis and production of plant sugars that are used for various plant metabolic needs [8]. The measure of soil Potassium is an important parameter which helps in identification of the different physiological processes of plants. Potassium of Sacorda cucurbita plantation soil varied from 201.6 to 509. 6 while at Farmagudi cucurbita plantation it varied between 287.8 to 752.6, showing that the soil was moderately in normal range. Wagh., *et al.* [20] suggested that the soil Potassium is considered to fall within a range from 112 to 840. It has been determined that most of the plant nutrients are optimally available to plant within this Potassium range.

Phosphorus occurs in soil in both organic and inorganic form. The inorganic form is more important for the crop nutrition. Most of the Phosphorus is absorbed by the plants as HPO_4- and H_2PO_4- ions or soluble organic phosphates. The availability of Phosphorus in soil is very variable because it depends on the mineral soil composition, organic materials and its rate of decomposition, local climatic conditions and mainly on pH [7]. Shivanna and Nagendrappa [21]. stated that the near neutral pH has a significant role in enhancing phosphorous availability. The available phosphorous content increases with pH value and decreases with organic carbon. The increase in phosphorous due to increase in pH may be due to lowering of activities of Fe^{3+} and Al^{3+} which increases the solubility of strangle and increases electro-negativity of colloidal complex with a consequent decrease in sorption of phosphorous. According to Singh., *et al* [22]. Phosphorus has been called the "Master key to agriculture" because low crop production is attributed mainly to the deficiency of phosphorus. The supply of Phosphorus at the early vegetative growth phase strengthens reproductive parts and formation of seeds [7]. The monthly variations of the phosphorus of Sacorda Cucurbita plantation soil ranged from 9.5 to 84 kg/Ha while at Farmagudi Cucurbita plantation it varied between 114.8 to 392 kg/Ha. This could be because of application of more amounts of phosphorus rich chemicals during plant growth. Since Sacorda plantation area is in the mining belt the soil may be less fertile and showing less amount of the nutrients.

During the study period the following diseases were encountered from the study sites.

Lesion of fruit

Brown roughly circular lesions with yellow edges on leaves, petioles, stem or fruit. These lesions are caused by fungus as seen in plate IIa. The disease was controlled by using fungicides and by crop rotation.

Belly rot lesions

These were water soaked initially but quickly dry and become shabby. The symptoms of belly rot were seen in the form of yellow brown discoloration of fruit and water-soaked spots on the side of fruit that is in contact with the soil also brown mould growing on rotting areas, collapse of seedlings is common in belly lesions. The causal agent was fungus *Rhizoctonia* that prevails in warm and humid conditions. The disease was controlled by tilling the soil deeply prior to planting, by using plastic and soil mulch to create barrier between fruit and soil (Plate IIb).

Aphides

These are cosmopolitan pests and highly polyphagus, prefer to feed on cucurbits. Aphids were found to be destroying the crop plants at Sacorda plantation. The farmers controlled them with the help of pheromone traps. These traps were hung in the fields at several place at the same time the tender gourds were covered with polythene bags in order to protect them from insect attack (Plate IIc and d).

Conclusion

Cucurbita plantation is the first priority source of income for the farmers at Farmagudi then at Sacorda. The study was performed to understand monthly variations in selected parameters and to know the type of pathogens attacking cucurbits in both the places. From present study it is concluded that the soil sample Farmagudi plantation area showed higher content of potassium, electrical conductivity, organic carbon, phosphorus, and potassium as compared to Sacorda except pH which was higher at this study site. Interaction with farmers from both locations revealed that, mining activities have lot of impact on the local environment of Sacorda, during rainy

season soil from mining dumps is washed in the plantations, pathogen attack lowers yield of cucurbits grown at Sacorda and also this being a remote place lot of time is consumed in taking the produce to market. Still local people cultivate cucurbits for their livelihood.

Since the soil was more fertile; less degree of infection to cucurbits by pathogens at Farmagudi, this plantation showed more yield. Farming is profitable in this area as this place is nearer to city for the farmers to sell their produce. However, some wild animals like Peacock, Porcupine, and Rats destroy their crops. ICAR and Ela farm form the support system for the farmers involved in Cucurbita cultivation.

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