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Soil Properties in Agriculture Growing Areas of Manjoor

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Abstract

Manjoor is a predominant agricultural area in Kerala, South India engaged in intensive farming with immense pesticide application. The agriculture field is spread over 40 acres and the major crops cultivated in this area are Bittergourd, Snake gourd, Pea plant, Little gourd and Cucumber. Soil samples were obtained from six study sites of Manjoor . The samples were collected from the six sites which were representing regions that produce different vegetables like Peaplant (station 1), Bitter gourd (station2), Snake gourd (station 3), little gourd (station 4) and Cucumber (station 5). The station 6 is a pea plant growing area where pesticides are not added. A garden soil sample (station 7), from the nearby area was also collected every month during the period which was used as a control at a depth of 0-15 cms. The soil samples were collected at monthly intervals for three lifecycles of the crop (March 2003 to June 2003, August 2003 to November 2003 and January 2004 to April 2004). All these soil samples were air dried and analyzed for physical and chemical properties. The physico chemical characteristics of the soil revealed that the soil properties had a wide range of values for measured soil properties and showed spatial variation. Physico-chemical analysis of the soil revealed the nature of the soil to be acidic except the soils of station 1which was found to be alkaline in nature. Soil organic matter was high in station 6 while the moisture content was high in stations 1 and 6. Soil nutrient analysis revealed the presence of high concentration of available nitrogen in stations 1 and station 6

Keywords: Pedogenic, Spatial Variation, Pesticides, Intensive, Vegetable.

Introduction

Soil is a dynamic natural body developed as a result of pedogenic processes through weathering of rocks, consisting of mineral and organic constituents, possessing definite chemical, physical, mineralogical and biological properties, having a variable depth over the surface of the earth, and providing a medium for plant growth (Velayutham and Bhattacharyya, 2000). It is a fundamental resource base for agricultural systems besides being the main medium for plant growth. Soil functions to sustain crop productivity, maintain environmental quality and support animal and plant life as well.

The important soil chemical properties are due to nutrient elements in soils, organic matter and soil pH. The soil supplies all the essentials minerals elements required by the plants. Depending on the requirements by plants these elements are grouped into two types such as macro elements which include nitrogen, phosphorus, potassium, calcium, magnesium and sulphur and micro elements which include iron, manganese, zinc, copper, molybdenum, boron, cobalt and chlorine. The properties of soil affect many processes in the soil that make it suitable for agricultural practices and other purposes

Properties of the soil vary according to the land use pattern and climatic conditions.In agricultural areas the natural properties of soil change due to the addition of a number of chemicals like pesticides. Agricultural pesticides most often are applied as liquids, granules or seed sprayed/treated on the crop and/or the soil. Extremely small percentage (less than 0.3%) of the pesticide applied, goes into direct contact with or consumed by target pests, therefore 99.7% goes somewhere else in the environment contaminating soil, water and air, where it can poison or adversely affect non target organisms (Pimentel, 1995).

As soil is the most important agricultural resource, next to water, it is important to study the possible effects of specific practices on soil properties. However the vegetable growing areas are quite different from fields that are growing perennials, in that they have short growing period of

3 to 4 months generating a high quantity of biomass by taking up large quantities of nutrients from soil. Hence it is important to understand the impact of agricultural practices on soil properties of study area.

Objectives

1. To determine the physico chemical properties of soil collected from different vegetable growing areas of Manjoor.
2. To analyse and describe the variation in nutrient levels collected from different vegetable growing areas of Manjoor.

Materials and methods

Study Area

Manjoor is a predominant agricultural area in Kerala, South India engaged in intensive farming with immense pesticide application. The agriculture field is spread over 40 acres and the major crops cultivated in this area are Bittergourd, Snake gourd, Peaplant, Little gourd and Cucumber.

Soil sampling for analysing physicochemical properties of soil

Soil samples were obtained from six study sites of Manjoor .The samples were collected from the six sites which were representing regions that produce different vegetables like Pea plant (station 1), Bitter gourd (station2), Snake gourd (station 3), little gourd (station 4) and Cucumber (station 5). The station 6 is a pea plant growing area where pesticides are not added. A garden soil sample (station 7), from the nearby area was also collected every month during the period which was used as a control at a depth of 0-15 cms. The soil samples were collected at monthly intervals for three lifecycles of the crop (March 2003 to June 2003, August 2003 to November 2003 and January 2004 to April 2004). All these soil samples were air dried and analyzed for physical and chemical properties.

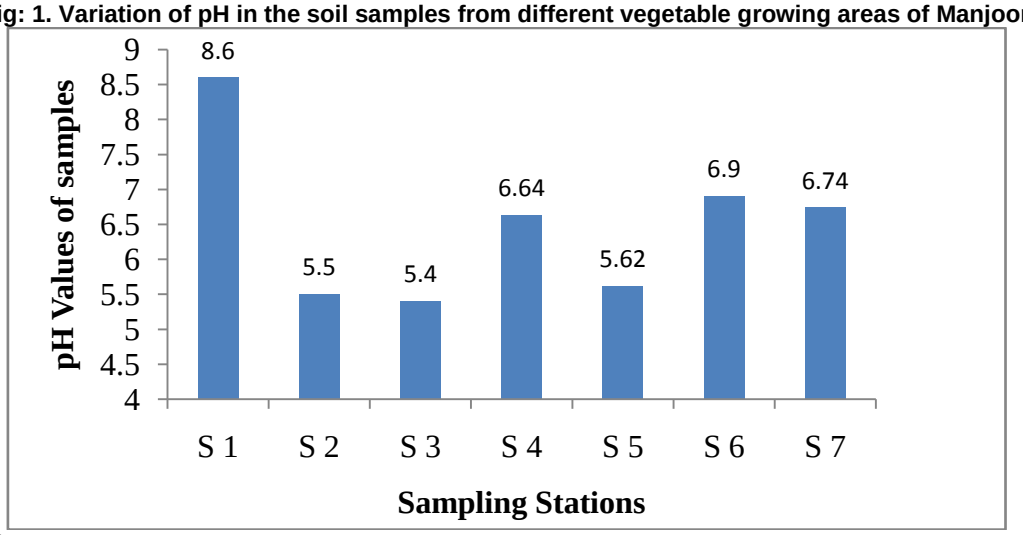
Results

Physico chemical characteristics of soil samples

Hydrogen ion concentration (pH) of soil

The pH of soils collected from various crops varied from 5.4 to 8.6 during the period from March 2013 to April 2014. The variation in pH of the soil samples collected from the agricultural crops of Manjoor is represented in Fig 1. The pH of the soil samples collected from all stations was acidic in nature with an exemption of Station1 which was alkaline. Soil samples of Station 2, Station 3 and Station 5 was highly acidic in nature compared to the pH of soils collected from Station 4 and Station 6 which were slightly acidic. The pH of the soils of Station 4 and Station 6 were similar to the pH of the control soil. There is no significant difference in pH between months (P › 0.05) while sampling stations showed a significant difference in pH (P ‹ 0.001).

Fig: 1. Variation of pH in the soil samples from different vegetable growing areas of Manjoor



Moisture Content

Moisture content of the soil samples was high in all the soil samples compared to the control soil. The mean moisture content of the soil varied from 5.2% to 24.1%. The variation in moisture content in the soil samples is represented in Figure 2. There is significant difference between months as far as moisture content is concerned (P ‹ 0.01). In the month of August, the moisture content is significantly higher compared to other months. There is also significant difference between stations with respect to moisture content (P ‹ 0.001). Station 1(S1) and S6 are having significantly higher moisture content compared to other stations. Station 7(S7) is having significantly low moisture content.

Organic Matter

Organic matter concentration in soil samples collected from different vegetable growing areas of Manjoor and organic matter concentration in control soil is represented in Figure 3. The percentage of mean organic matter content in the soils varied from 0.16 to 3.2%.There is significant difference between months with respect to organic matter (P ‹ 0.05). March, April, May, June, August and September are having significantly high organic matter compared to October and November. The presence of organic matter between stations also showed significant difference (P ‹ 0.001). Station 6(S6) is having significantly higher organic matter and station (S7) is having significantly lower organic matter.

Fig: 2. Variation of moisture content in the soil samples from different vegetable growing areas of Manjoor

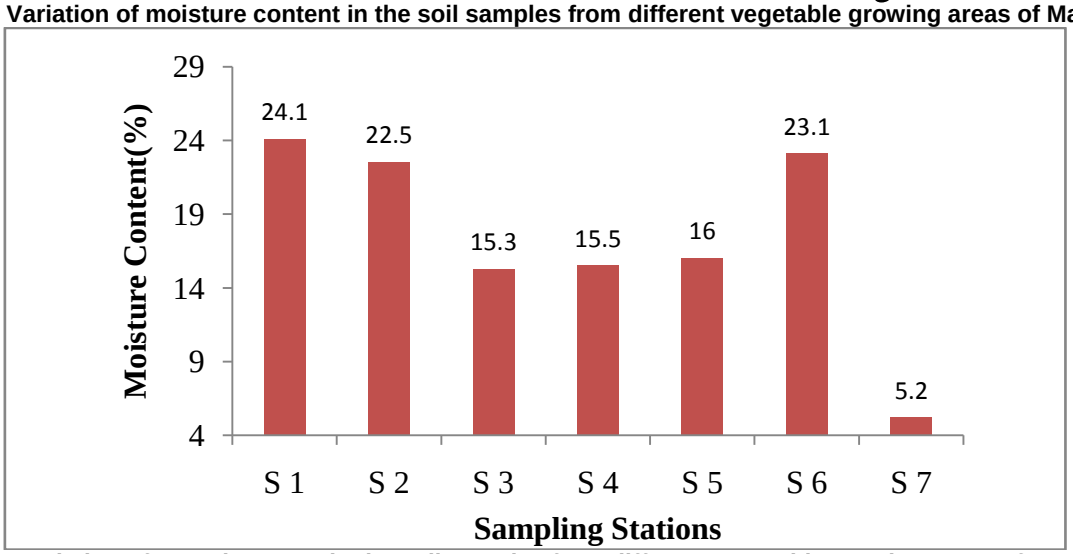
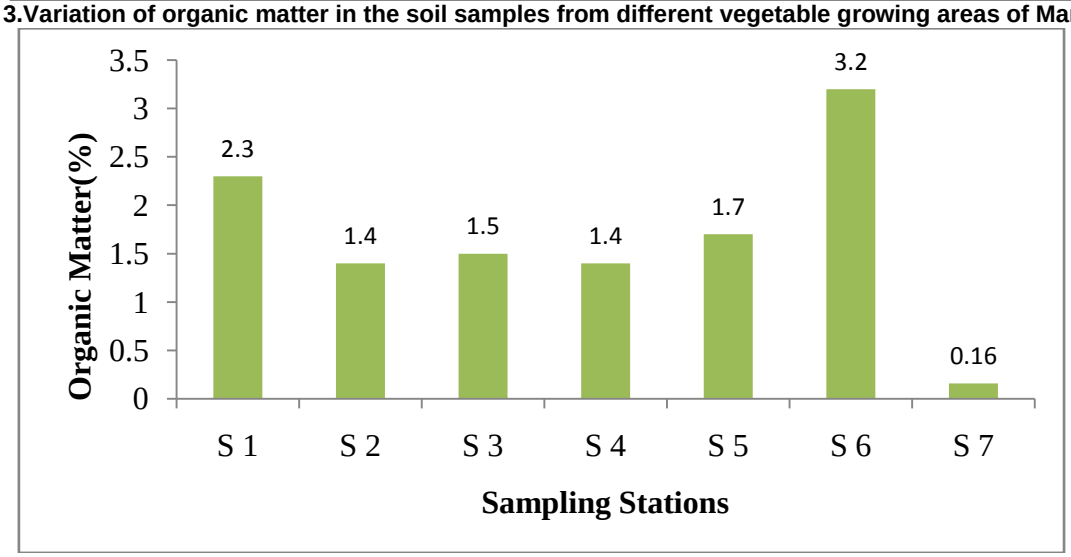


Fig: 3.Variation of organic matter in the soil samples from different vegetable growing areas of Manjoor



Soil Nutrient

Available Nitrogen

Concentration of mean available nitrogen in the soil samples collected from different vegetable cultivating areas of Manjoor ranged from 169 to 760 (Kg/h) which is represented in Figure 4. Available nitrogen showed a significant difference between months (P‹ 0.05). March and April are having significantly higher amount of Nitrogen compared to other months. Stations also exhibited significant difference in available Nitrogen (P ‹ 0.001). Stations (S1) and S6 are having significantly higher amount of Nitrogen and station 7 is having significantly low amount of Nitrogen. When comparing the estimated values of nitrogen with critical limits for delineation of soil fertility the soil samples of station 1and station 6 are having high nitrogen. In the stations 2, 3, 4 and 5, the concentration of available nitrogen was medium, while it was low in station 7. Critical limits for soil test values (available NPK) used in India are summarized in Table 1.

Fig: 4. Variation of available nitrogen in the soil samples from different vegetable growing areas of Manjoor

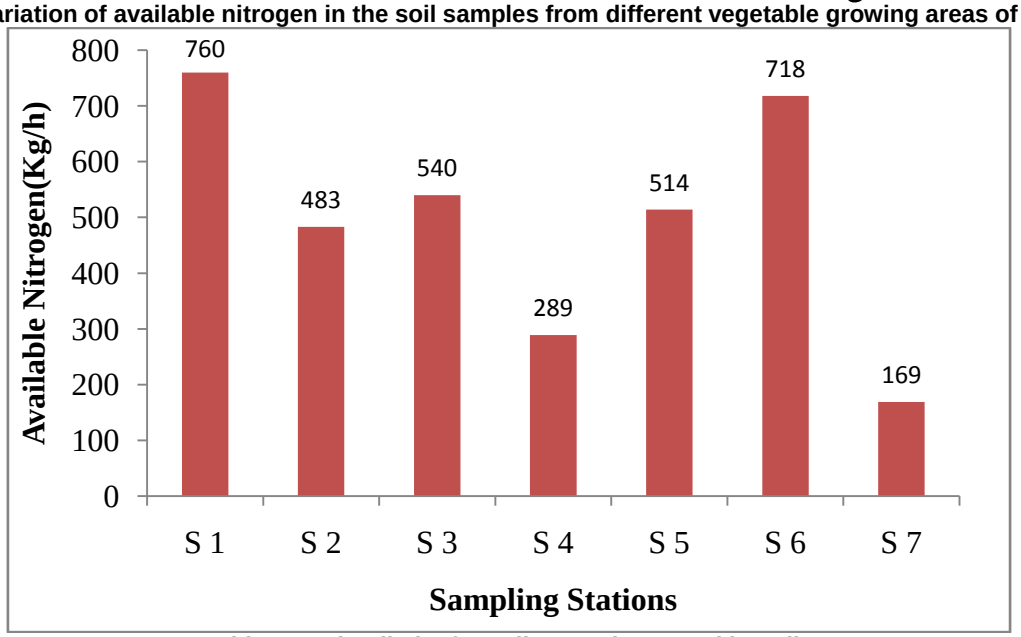


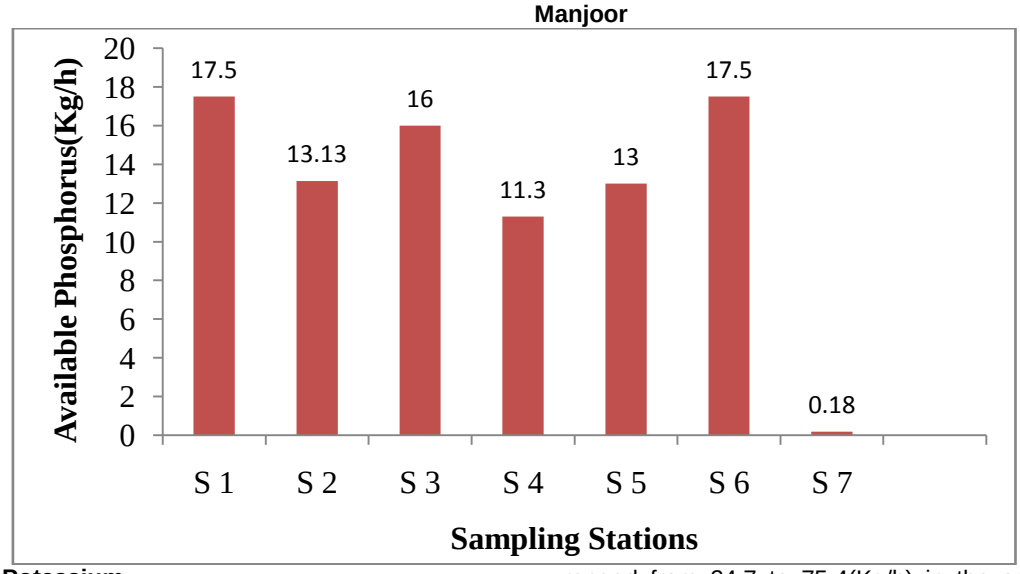
Table 1. Rating limits for soil test values used in India

Nutrients	low	Medium	High
Available Nitrogen (Kg/ha)	<280	280-560	>560
Available Phosphorus(Kg/ha)	‹<10	10-24.6	>24.6
Available Potassium (Kg/ha)	<108	108-280	>280

Available Phosphorus

Variation of available phosphorus in the soil samples collected from different vegetable cultivating areas of Manjoor ranged from 0.1(8Kg/h) to 17.5 (Kg/h) which is represented in Figure 5. Between months the difference in phosphorus is not significant (P › 0.05) but the amount of phosphorus between stations differ significantly (P ‹ 0.001). Station 6(S6) experienced significantly higher amount of phosphorus while station 7(S7) is having significantly lower phosphorus. When comparing values of available phosphorus with the critical limits for soil test values (available NPK) used in India, all the soil samples comes under the medium range while the soil samples of station 7(S7) are low in the concentration of available phosphorus.

Fig: 5. Variation of available phosphorus in the soil samples from different vegetable growing areas of Manjoor

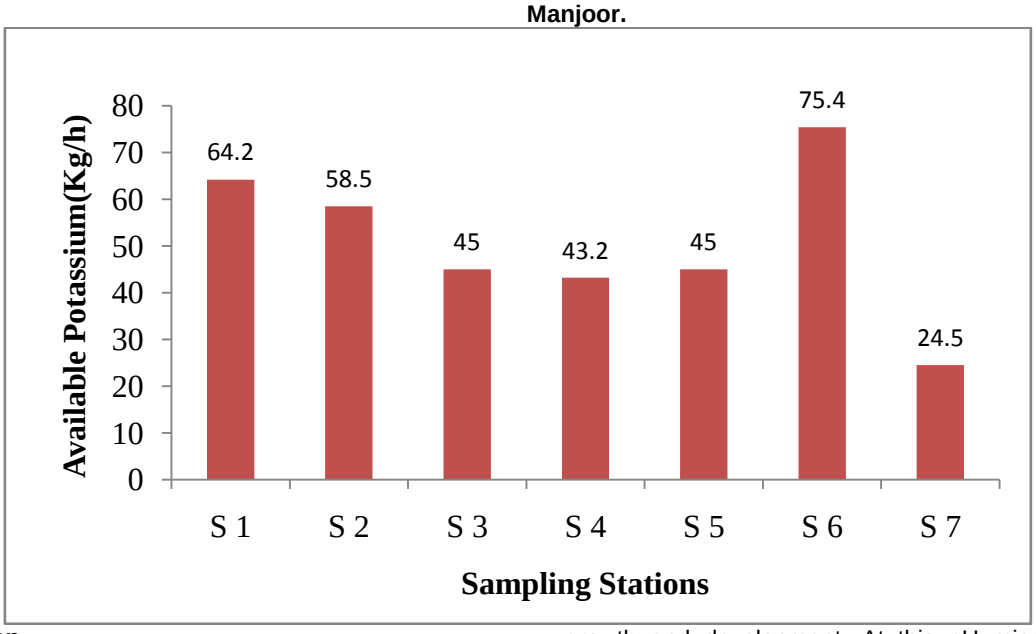


Available Potassium

Available potassium concentration in soil samples collected from different vegetable growing areas of Manjoor and control soil is represented in Figure 6. The available potassium concentration ranged from 24.7 to 75.4(Kg/h) in the soil samples analysed. Statistical analysis indicates that Potassium concentration varied between stations significantly (P ‹ 0.001). Station 6(S6) is having significantly higher amount of Potassium while station 7(S7) is having

significantly lower Potassium. The soil samples of Manjoor were low in available potassium when compared with the critical limits for soil test values used in India.

Fig: 6. Variation of available potassium in the soil samples from different vegetable growing areas of Manjoor.



Discussion

Soils have chemical, biological and physical properties that interact in a complex way to give a soil its quality or capacity to function. Soil quality cannot be measured directly, but must be inferred from measuring changes in its attributes or attributes of the ecosystem, referred to as indicators. Soil physical, chemical and biological properties are suggested as important soil quality indicators. Pesticides occupy a unique position among the many chemicals encountered in soil. They alter the physico chemical characteristics of soil. World soil resources being finite, intensive land use is inevitable to meet the global demands for food and fiber. Intensification of agriculture on existing arable land increases risks of soil and environmental degradation. Therefore, it is important to understand land use and management impacts on soil quality.

Physico chemical characteristics of the soil

Results of the physico chemical characteristics of the soil of present study revealed that the soil properties had a wide range of values for measured soil properties and the physicochemical parameters of the soil showed spatial variation.

pH

In the present investigation the pH of the soil samples ranged from 5.4 to 8.6. Major factors governing soil pH include the concentration of reduced iron, manganese, hydroxides, carbonates, carbonic acid and humic acid (Patric and Mikkelson, 1971). All the soil samples analyzed were acidic in nature except for the station 1, where the soil was basic in nature. The various sources of soil acidity are carbonic acid, microbial oxidation of NH^{4+} to NO^{3-}, atmospheric pollution and the decomposition of organic matter. The acidic soils of the present study had a pH ranging from 5.4 to 6.9 which is suitable for most vegetable crops. This pH range can assure high bioavailability of most nutrients essential for vegetable growth and development. At this pH microbes can increase nutrient bioavailability and promote plant nutrient uptake (Das et al., 2010). The Alkaline nature of station 1 can be due to the excessive liming in the site.

Moisture content

Moisture content observed in this experimental stations was high when compared with the control soil of station 7(S7) and there was significant difference between stations with regard to moisture content. The higher moisture content in the soils of Manjoor when compared to the control soil can be attributed to the method of cultivation in raised mounts of 2 to 7 feet in wetlands which helps in the retention of moisture content in the soil. Station 1(S1) and station 6(S6) was having significantly higher moisture content where the presence of organic matter was also found to be high. Similar discussions were reported earlier by Haynes and Naidu (1998). An increase of 1% SOM (soil organic matter) can add 1.5% additional moisture by volume. Increased level of organic matter in soils leads to greater pore space with the immediate result that water infiltrates more readily and is held in the soil as a result of improved soil structure and macro porosity as reported by Aluko and Oyedele (2005).Soil moisture content varies widely in soils and also affects microbial populations, their activities and biochemical transformations (Subhani et al., 2001).

Organic matter

The organic matter is a vital store of available nutrients. It helps to sustain soil fertility by improving soil structure, retention of mineral nutrients, increasing water holding capacity, water infiltration, drainage, aeration and root penetration. It also helps to increase the amount of soils flora and fauna. Thus the organic matter is an important factor that contributes to soil fertility. Organic matter levels in soils are also vital to productivity and sustainability

(Wilhelm, 2001). The concentration of organic matter in soil samples collected from different vegetable growing areas of Manjoor varied from 1.4 to 3.2% which was higher than that of the control soil (0.16%). Station 6(S6) is having significantly higher organic matter and the concentration of organic matter varied from 1.9 to 3.9%. Field experiments were conducted by (Bulluck 2002) to examine the effects of organic and synthetic soil fertility amendments at Virginia and found that the concentration of organic matter was 2.83% in organic amended soils. The organic amendments increases the amount of organic matter in the soil and results in nutrient availability and substrate for most soil biological activity (Bunning and Jimenez, 2003). The soil typically has organic matter content of 1-3 % (Low, 1983; Mitchell et al., 1983). In station 1 the levels of organic matter was comparatively high which can be due to higher crop residue fall. Haynes and Naidu (1998) noted that after addition of easily decomposable organic matter, there was a flush of microbial activity, fungal growth and production of extracellular polysaccharides, resulting in a rapid rise in aggregate stability.

Soil Nutrients

Available Nitrogen

Nitrogen is an important nutrient element in the soil and is also an important limiting crop nutrient in soil. Nitrogen sources are mainly the product of oxidation of nitrogenous organic matter and are depended upon temperature, rainfall, moisture content and biological activities. In Stations S1 and S6 concentration of available nitrogen in the soil was high, compared to the remaining stations. Station1 had higher concentration of available nitrogen compared to station 6 which can be attributed to the slow release of nutrients from the organic matter (Brown, 2004) in station 6(S6).The high value of available nitrogen in station 1 can be due to the combined effect of fixation of atmospheric nitrogen by the leguminous pea plant (Simek, 1999) and to the addition of urea which is destined for use as nitrogen release fertilizer (Chauhan et al., 2011). Even as urea is applied in all the stations (S2, S3, S4, S5 and S7), the concentration of available nitrogen was found to be less. It can be as a result of crop uptake, immobilization by microorganisms and nitrogen loss through volatilization (Defoer, 2000). Concentration of available nitrogen is low in station 7, since it is reported that the deficiency of nitrogen is almost universal in Indian soils (Deshmukh, 2012).

Available Phosphorus

Phosphorus (P) is the second most important macro-nutrient required by plants, next to nitrogen. Compared to other essential macronutrients (with exception of nitrogen), P is one of the less-abundant (0.1% of total) elements in the lithosphere (Jones and Oburger, 2011), thus often regarded as a limiting nutrient in agricultural soils. Therefore, it becomes quite common to use chemical fertilizers. Upon application, inorganic phosphorus is rapidly transformed into less available forms by forming a complex with Al (Aluminium) or Fe(Iron) in acid soils or with Ca(Calcium) in calcareous soils (Toro, 2007) thus becomes unavailable to plants. The Studies by Tripathi (2013) in rhizosphere of Lycopersicumesculentum revealed a concentration of 44.1(kg/h) of phosphorus which is greater than the concentration of available phosphorus observed in the present study. Variation of available phosphorus in the soil samples collected from different vegetable cultivating areas of Manjoor ranged from 0.1(8Kg/h) to 17.5 (Kg/h). The concentration of available phosphorus in soil samples of Manjoor was medium.

Available Potassium

The mean available potassium concentration in the agricultural field soils ranged from 43.2 to 75.4(Kg/h) which was higher than the concentration of available potassium in control soil (24.5Kg/h). The available potassium concentration in soils of Manjoor is low. The factors that affect availability of K in the soil and resulting plant uptake are soil factors, plant factors, fertilizer inputs and field management. The station 6 where there is application of organic fertilizers, the level of available potassium was high. Das et al.,(2011) also observed a higher concentration of available potassium. The Studies by Tripathi (2013) in rhizosphere of Lycopersiconesculentum revealed a concentration of 330.1(kg/h) of potassium which is greater than the values of available potassium encountered in the present study.

Conclusion

Manjoor is an important vegetable growing area where there is immense application of pesticides. Physico-chemical analysis of the soil revealed the nature of the soil to be acidic except the soils of station 1 which was found to be alkaline in nature. Soil organic matter was high in station 6 while the moisture content was high in stations 1 and 6. Soil nutrient analysis revealed the presence of high concentration of available nitrogen in stations 1 and station 6.

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