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Fertility status of typical horticultural and mulberricultural soils of Baramulla, Kashmir

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ABSTRACT

A comparative study on the physico-chemical properties of horticultural and mulberricultural soils was carried out in the Baramulla district of north Kashmir.

The investigation revealed that the horticultural soils were more fertile as they possess comparatively higher concentration of nutrients especially calcium, magnesium, and total nitrogen than mulberry cultural soils. Both the study sites were found to be rich in organic carbon due to the accumulation of organic matter in the form of plant litter and the addition of organic manure. Values observed in case of total phosphorous at both the sites were found to be lower for plant growth except that estimated in the month of March. On the basis of results obtained, it was found that horticultural soils were more fertile as compared to mulberricultural soils.

Key Words: Horticultural, mulberricultural, soils, nutrient status, north Kashmir

INTRODUCTION

Soil is a dynamic source that supports plant life and is made up of different sized mineral particles, organic matter, and numerous species of living organisms. Thus soil has biological, chemical and physical properties, some of are dynamic and can change in response to how the soil is managed (Anonymous, 2001). Soil is a fundamental resource for the production of agricultural and horticultural production systems. Like other agricultural crops, the yield of horticulture and sericulture crops has also direct bearing upon the fertility level of the soil. It has been observed that in order to have good harvest of mulberry leaf per hectare, the soils have to be fertile and capable of supplying all the macro and micro-nutrients in appropriate proportion (Anonymous, 1988). In this regard soil analysis is very useful to provide information necessary for maintaining and manipulating fertilization programmes. Although many studies have been conducted to evaluate the effects of fertilizers on plant growth and establishment and on plant response to insect/disease pressure (Ali, 2006; Landis *et al.*, 2005; Salifu and Timmer, 2003; Salifu *et al.*, 2006; and Waring and Cobb, 1992), availability of nutrients in the landscape bearing apple and mulberry trees is almost unavailable. The present investigation was conducted on two typical sites of mulberry culture and horticulture soils in Baramulla district of Kashmir valley during March to June, 2006. It was an attempt to assess the nutrient status of the two types of soils and for this purpose estimation and assessment of parameters such as moisture content, soil pH, electrical conductivity, loss on ignition, organic carbon, organic matter, total nitrogen, total phosphorous, exchangeable potassium, exchangeable calcium and exchangeable magnesium was carried out.

STUDY AREA

The present study was conducted at two typical sites in and around Baramulla, Kashmir (Fig.1a) on the basis of characteristic type of vegetation (i.e. mulberriculture and horticulture). The selected study sites included:

Site 1: Mulberricultural soils

It was located at Mirgund, Baramulla, at a distance of about 18 km from Srinagar city to its north-west. The soil samples were taken from the three differently managed mulberry (*Morius alba*) plantation.

Site 2: Horticultural soils

This site was located at Dewar at a distance of about 21 km from the Srinagar city to its north-west. The soil samples were taken from the three different varieties of horticultural plots bearing three different varieties apple (*Pyrus malus*) vegetation.

Figure 1a: Outline map of Kashmir valley showing study sites in Baramulla

MATERIAL AND METHODS

To determine the physico-chemical properties, composite surface soil samples (0 – 10 cm deep) were collected by digging the earth sequentially at the two selected sites. The samples were stored in polyethylene bags for subsequent laboratory investigations. In the laboratory, the moisture content of the fresh samples was determined first and then the air dried samples were slightly crushed with pestle mortar and passed through 2mm sieve for further analysis. The analysis was carried out according to standard methods (Walkley–Black, 1934; Piper, 1966; Michael, 1984; Saxena, 1998 and Gupta, 2000).

RESULTS AND DISCUSSION

The quality of soil has a profound impact on the health and productivity of a given agro-ecosystem and on the ecosystems that interface with it. Fairly definitive standards have been defined for air and water quality, but the definition and assessment of soil quality is comparatively difficult. Because soil is not directly consumed by humans or animals and performs many simultaneous functions, it becomes difficult to relate measureable soil indicator properties specific soil functions or management goals (Mitchell *et al.*, 2000). However researchers and farmers have tried to establish data sets of physical, chemical and biological properties that can be used as quantitative indicators in soil health assessment (Abdul-Baki and Teasdale, 1997; Doran *et al.*, 1994 and Mitchell, 1994). In the present study an attempt has been made to assess the main soil characteristics of mulberricultural and horticultural area soils and the results obtained are depicted in figures 1 – 10.

Soil moisture has a definite and well marked effect on the plant growth. In general the total moisture content increases during the rainy season and decreases during the hot dry season. The overall soil moisture at both the sites ranged between 8.82% and 17.34% (Fig. 1). Minimum soil moisture of 8.82% was recorded in the horticultural area during March and the highest value of 17.40% was also observed in the same area during April. In case of mulberry cultural soils, the moisture content ranged between 8.56% and 17.10% while for horticultural soils it ranged between 8.82% and 17.34. In both the cases the maximum values were observed in the month of April. It was obviously because of heavy rainfall in the month. In general it was observed that higher moisture content corresponded to rainy season and lesser values to hot-dry summer intervals.

The pH of the soil almost remained on the alkaline side and showed a decreasing trend throughout the study period (Fig. 2). In the month of April, the pH value in mulberricultural area was slightly acidic and minimum value of 6.86 was recorded at the same site during April while the maximum value of 7.66 recorded again at this site in March. The higher values were observed during the months of March and May. The soil samples were found to be slightly acidic in April that can be related to the heavy rainfall and may have resulted in the leaching of bases. In comparison, the pH values of horticultural soils ranged between 6.89 and 7.62. The pH was slightly alkaline during the months of March and April. The acidic nature of the soils during the months of May and June may be related to the probable decomposition of organic matter and formation of organic and inorganic acids and also due to the addition of chemical fertilizers during these months. This observation finds support from the experimental work of Verma *et al.* (1990) who reported a pH range of 5.4 and 6.7 in the forests soils of Kashmir.

The electrical conductivity values depicted a decreasing trend from March to April with an increase in the months of May and June (Fig. 3). The maximum value of 615 for horticultural site was observed in the month of May while the minimum value of 288 was observed at mulberricultural site in April. The electrical conductivity from March to June in case of mulberricultural soils ranged between 288 and 381 $\mu S/cm^2$. The maximum value was observed during the month of June followed by March. The increase in the conductance values was probably due to application of fertilizers, presence of high soluble salts, and high temperature. The comparatively lesser value observed in the month of April could be due to uptake of ions by growing plants and due to heavy rains.

Loss on ignition varied from site to site (Fig 4). The maximum value of 9.2% was recorded for horticultural site in May and June while the minimum value of 5.2% in the month of March for mulberricultural site. The values of loss on ignition were high during the month of June followed by May in mulberriculture soils probably due to high decomposition rate of agricultural and animal wastes applied during the rainy season. In case of horticultural soils, loss on ignition values ranged between 6.4% and 9.2%. In this case the maximum values were also recorded in the months of May and June.

Organic carbon values remained fluctuating during different months (Fig. 5). A maximum value of 4.68% was recorded in the horticultural area in April while a minimum of 1.37% was observed at mulberricultural site in the month of March. The organic carbon value in case of mulberry culture soils was observed to be higher in March and lower during the month of June that may be due to the absorption of nutrients by growing vegetation from the soil and lesser or no addition of organic matter in terms of falling leaves from the mulberry plantation, because the leaves are being used as feedstuff to the silk worms. In contrast, the horticultural soils depicted higher values in the months of May and June which may be due to the decomposition of agricultural and animal wastes.

This nutrient appeared to be fluctuating during different months (Fig 6). The highest of 0.30% was estimated for horticultural area soil in the month of April while a minimum of 0.07% was observed for the mulberricultural area soil in the month of March. Season wise total nitrogen content in case of mulberry cultural soils was observed maximum during the month of April. This may be due to the application of chemical fertilizers, especially urea, during this period. On the other hand, in case of horticultural soils, maximum values were recorded during March. The concentration of nitrogen is appeared to increase during summer and rainy season. Nye and Greenland (1960) have reported that heating soil to 45 – 50 °C increases the rate of nitrogen mineralization and soil fertility. Harmson and Van-Schreven (1965) have also concluded that mineralization of nitrogen was optimum in spring and increased in summer and rainy season.

The values of total phosphorous also remained fluctuating throughout the study period (Fig. 7). The lowest average value of 30µg was observed for mulberricultural site in April while the maximum value of 390µg was observed during the month of March for horticultural site. During the present study, the total phosphorous content in mulberricultural soils was found maximum during March. In general, the values ranged from 30 – 65µg from April to June. The same trend was also observed in case of horticultural soils. It may be attributed to the application of chemical fertilizers during the months of March and its increased uptake by plants from April to June.

Exchangeable potassium values remained fluctuating with an average highest value of 65.0mg for horticultural site in the month of March and lowest of 19.5mg for the same site in the month of May (Fig. 8). The value of exchangeable potassium in mulberricultural soils was maximum but optimum in the month of April that may be related to the application of fertilizers in the fields. The minimum value was observed in the month of June. It can be due to the utilization of the fertilizers for crop growth and development. In horticultural soils, the concentration of potassium showed the same trend as in case of mulberricultural soils.

The exchangeable Ca^{++} values remained fluctuating throughout the study period (Fig. 10). The lowest average value of 3.4me/l was observed for both horticultural site and mulberricultural site in the months of March and April respectively. The maximum average value of 4.8me/l was observed for mulberricultural site in March. The concentration of exchangeable calcium was found to decrease during rainy periods in mulberricultural soils that can be attributed to the leaching of the salt due to heavy rains in the season. Acidification due to leaching or otherwise may cause calcium and few micro-nutrients more rapidly out of the soil (Agarwal and Tiwari, 1997). This observation also gets support from the work of Johnson *et al.* (1994) who reported that decrease in concentration of exchangeable calcium are generally attributed to their displacement by hydrogen ions. In horticultural soils exchangeable calcium concentration was less during March and increased from April onwards. Higher values were observed during summer season under low rainfall and high temperature regime. Black (1969); Etherington (1975) has also reported that lower water table increases nutrient availability, enhancing the mineralization of soil and increasing calcium content during these periods.

Exchangeable magnesium values were recorded minimum as 0.80me/l for mulberricultural area soil in the month of March and maximum as 2.92me/l for horticultural area soil again in the month of March (Fig. 11). The values of exchangeable magnesium have also showed similar trends with almost similar reasons as observed in case of exchangeable calcium.

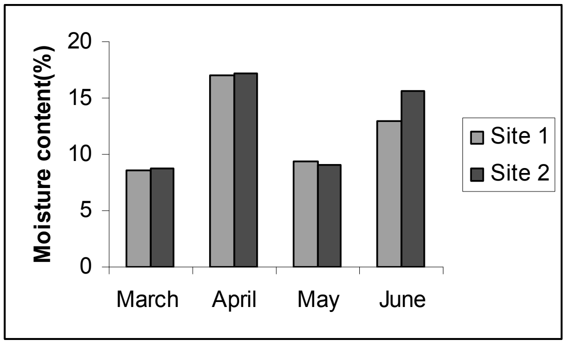

Figure 1. Moisture content (%)

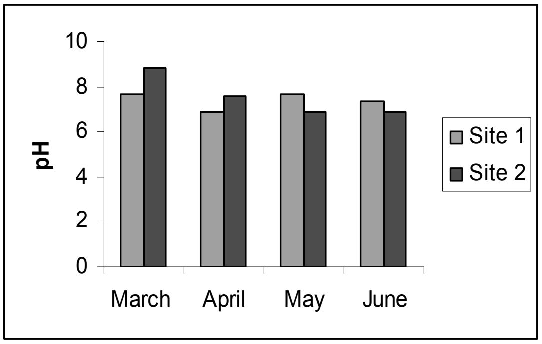

Figure 2. pH values

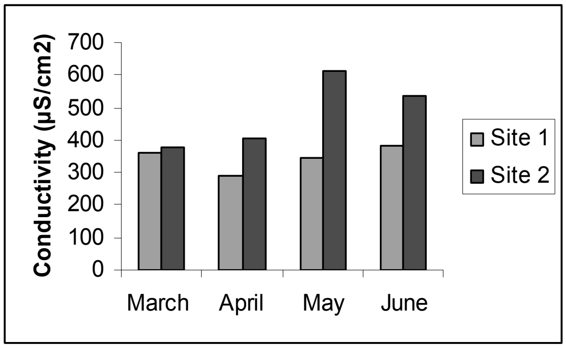

Figure 3. Conductivity (µS/cm^2)

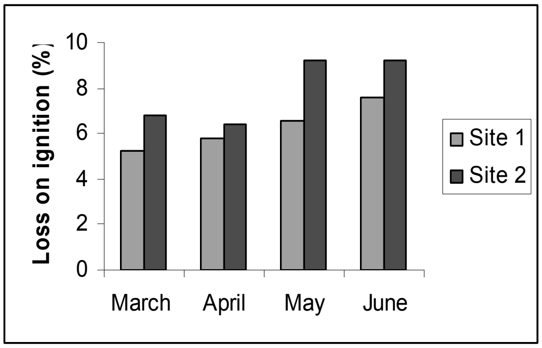

Figure 4. Loss on ignition (%)

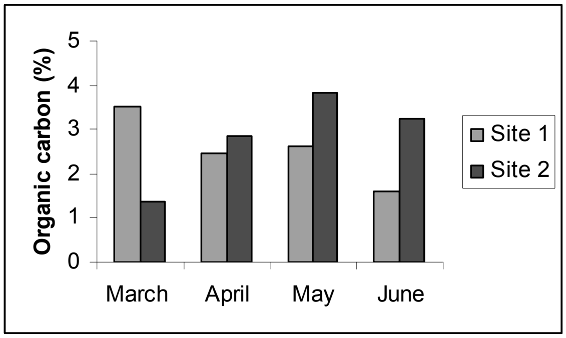

Figure 5. Organic carbon (%)

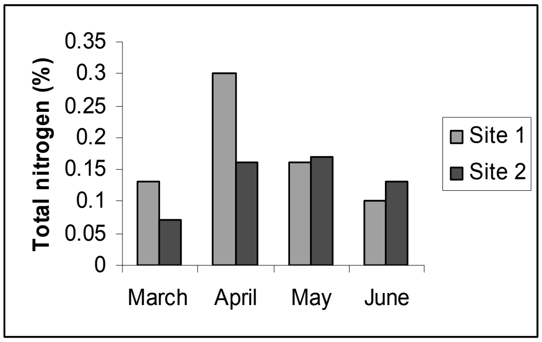

Figure 6. Total nitrogen (%)

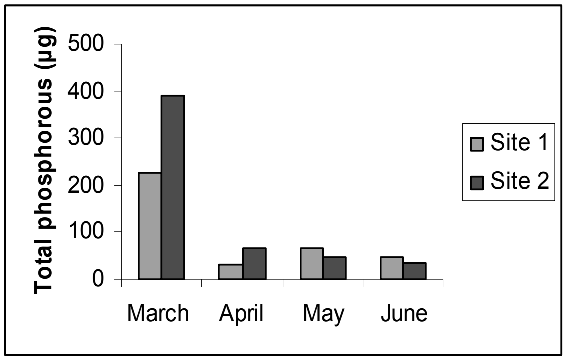

Figure 7. Total phosphorous (µg)

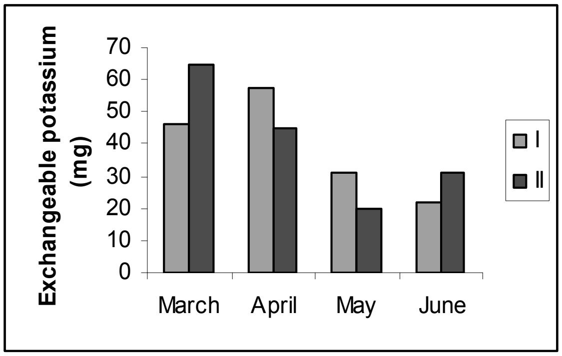

Figure 8. Exchangeable potassium (mg)

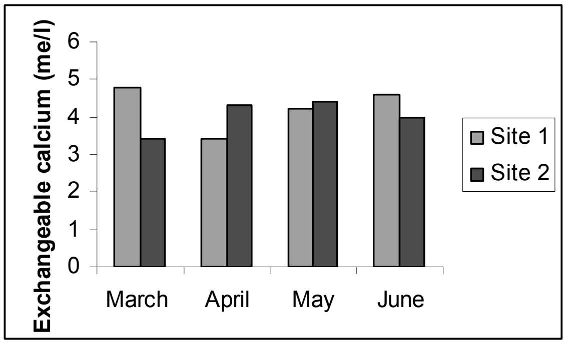

Figure 9. Exchangeable calcium (me)

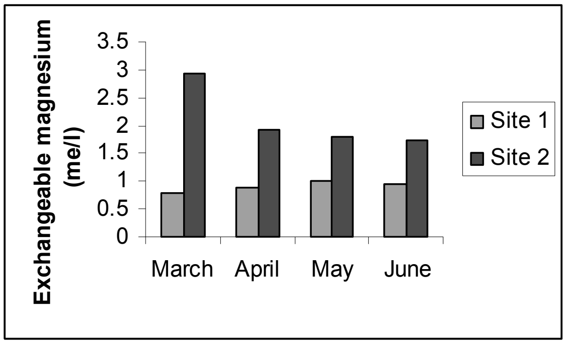

Figure 10. Exchangeable magnesium (me)

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