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Nutrient Status in Relation to Rhizosphere Microflora of Mulberry Gardens in different Regions of Kashmir

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Abstract: ***The study entitled Nutrient status in relation to rhizosphere microflora of mulberry gardens in different regions of Kashmir was performed to better understand the bacterial communities in mulberry growing soils/locations and their association with various chemical properties of soils. The chemical properties of mulberry soils evaluated in this study varied across various regions and showed a positive correlation with rhizosphere microflora. It was observed that mulberry soils differ in the diversity and density of microorganisms in relation to chemical properties. The higher abundance of microorganisms was found mostly in the Northern region which may be because of better nutrient availability, soil moisture and other climatic factors. Soil Organic carbon and Potassium was however, highest in the Southern region but deficient in other parameters.***

1. Introduction

The silk industry has an ancient tradition of sericulture under temperate climatic conditions of Kashmir. Soil is the habitat of diverse microorganisms and an important factor which has to be analyzed before the rearing, as the nutrient status of the soil and the population of Microflora determines the quality of leaf produced which provide the nutritional requirements to the growing silkworms. Mulberry leaf is harvested repeatedly from the plant leading to continuous loss of nutrients in the soil. However, high levels of biomass production coupled with non borders of agricultural fields, (Ahsan et *al*., 1990) etc with no inputs from farmers/rearers, the tree is cultivated in nutrient deficient land, thus deteriorating the quality and quantity of leaf (Dhar and Khan, 2004) which is one of the limiting factors for cocoon production and affect the production of mulberry raw silk. The average bivoltine silk produced is 55.0Kg/100 DFL'S where as in Jammu & Kashmir, it is around 35.0 - 40.0 Kg/100 DFL'S. Thus Mulberry plant/tree requires essential nutrients to sustain growth and development from the soil. Soil consists of mineral elements, organic matter and living organisms. The soil Microflora plays a significant role in mobilization, mineralization and solubilization of nutrients for proper growth and development of plants. As such in mulberry farming the exploitation of microbial complex present in the soil is of paramount importance not only because of their eco - friendly and beneficial nature but also for overall sustainability of sericulture. This implies to management and application of standard package of practices under organized plantation which leads to better plant growth and leaf yield. In this regard, soil analysis is very useful to provide information necessary for application of fertilizers have resulted in prolonged exhaustion of nutrients, variability in crop performances and imbalances in nutrient availability in different Mulberry gardens/Nurseries of Kashmir. It has been reported that production of 20, 000 Kg Mulberry leaf removes 200 - 230 Kg Nitrogen, 40 - 45 Kg Phosphorus and 200 - 211 Kg Potassium, besides, stems and older leaves also lock about 226Kg Nitrogen, 50 Kg Phosphorus and 204 Kg Potassium (Rathore, M. S & Srinivasulu, Y., 2018). Under Kashmir conditions, mulberry tree is grown on road sides, river bunds, maintaining and manipulating fertilization programs. Although, many studies have been conducted to evaluate the effects of fertilizers on plant growth and establishment (Ali, 2006), but the literature pertaining to availability of nutrients in relation to rhizosphere Microflora of mulberry trees is almost scarce. So, the present study was conducted to investigate the Northern, Central and Southern regions of Kashmir Valley. It was an attempt to assess the nutrient status in relation to rhizosphere Microflora in different Mulberry gardens of Kashmir.

2. Study Area

The present study was conducted at Division of Soil Science - Shalimar and BiofertilizerResearch Laboratory, FoA, Wadora, SKUAST - K. The selected study sites included the following details: -

1) Regions: 03 (North, Central and South)
2) Districts in each region: Baramullah and Bandipora from Northern region
   Srinagar and Pulwama from Central region
   Anantnag and Kulgam from Southern region
3) No. of Locations from each region 03
4) Samples per location 05
5) Sampling months Ist fortnight of April
   Ist fortnight of July
   Istfortnight of October
   Ist fortnight of January
6) Design of survey Purposive sampling

3. Materials and Methods

***Soil sampling*: -** Soil samples were collected from 9 different locations of Kashmir valley. For nutrient analysis, soil samples were randomly collected upto a depth of 0 - 60 cm from pits between the mulberry plants. Soil samples for rhizosphere studies were taken from the soil adhering to the roots of mulberry in sterilized polythene bags. From each location, 10 samples, 5 each for nutrient and microbial analysis were collected and processed for following parameters: -

i) For Nutrient analysis:
Soil pH (Jackson, 1973), Electrical Conductivity (Jackson, 1973), Organic Carbon (Walkley & Black, 1934), Available Nitrogen (Subbiah & Asija, 1956), Available Phosphorus (Olsen, 1954 & Jackson, 1973), Available Potassium (Jackson, 1973).

ii) For Rhizosphere Microflora:
The samples were subjected to isolation and enumeration of various microorganisms to observe the regional differences as under:
Total viable Bacteria by Serial Dilution Pour Plate Technique (Aneja, 1993).
Total viable Fungi by Serial Dilution Pour Plate Technique (Martin, 1950).
Azotobacter and *Azospirillum* by Serial Dilution Pour Plate Technique (Aneja, 1993).
Phosphorus Solubilizing Bacteria by (Pikovskaya, 1948).
Vesicular Arbuscular Mycorrhiza by Wet Sieving and Decanting method (Gerdemann & Nicolson, 1963)

4. Results

4.1 Nutrient analysis

1) Soil pH:
Soil reaction was highest (7.04) in the Central region being statistically at par with the Northern region (7.00) and minimum (6.74) in Southern region.

2) Electrical Conductivity:
Northern region was statistically at par (0.19) with Southern region (0.18) in case of E. C where as the Central region registered the least value (0.16).

3) Organic Carbon:
Southern region registered the maximum (1.21) soil Organic Carbon being statistically significant with Northern region (1.07) and the least value (0.91) was recorded in Central zone.

4) Nitrogen
Soil Nitrogen was registered maximum (101.0) in the Northern region and was found statistically significant over the other regions with the least value (95.8) recorded in Southern region.

5) Phosphorous
Soil Phosphorous was observed maximum maximum (10.06) in the Northern region with the least value (8.59) registered in Southern region.

6) Potassium
Among the regions, Southern region recorded the maximum value (160.00) of Potassium and was significant over the rest of the regions with the least value (144.66) recorded in Central region.

However, in whole Valley, all the six parameters pH, E. C, O. C, N, P and K. showed the maximum value of (45.70) in Northern region which was significantly at par with Southern region (45.42) where as the least value (43.11) was recorded by all the above parameters in Central region of Kashmir.

4.2 Rhizosphere Microbial Analysis

1) Bacteria
Bacterial population was maximum (50.33) in Northern region being statistically higher than the values recorded in Southern (48.21) and Central regions (47.93)

2) Fungi
Among the regions, Northern region recorded the maximum value (7.30), whereas, Southern region registered the least value (5.00).

3) Azotobacter
Maximum value of (17.86) was reported from Northern region followed by Southern region (17.03) amongst the regions of Kashmir, whereas the Central region registered the least value (16.76).

4) Azospirillum
Azospirillum population registered the maximum value (16.11) in Central region (16.06) being statistically at par with the Northern region (16.06) and significant over the Southern region which registered the least value (14.08).

5) Phosphorous Solubilizing Bacteria
The population of Phosphorous Solubilizing Bacteria was maximum (14.11) in Central and Northern regions (13.91) as compared to Southern region (12.65) of Kashmir.

6) Actinomycetes
The population of Actinomycetes was maximum (10.80) in Central region which was however at par with value recorded in Northern region (10.73) but slightly greater than the value (9.90) recorded in Southern region of Kashmir.
In case of rhizosphere Microflora i.e., Bacteria, Fungi, Azotobacter, Azospirillum, Phosphorous Solubilizing Bacteria and Actinomycetes, the overall activities of the above microbes were maximum in Northern region (19.36) and at par with the Central region (18.66) whereas the least activity (17.81) was recorded in Southern region in whole Valley.

Table: Nutrient Status in relation to Rhizosphere Microflora of Mulberry Gardens of Kashmir

Nutrients/chemical properties	Northern region	Central region	Southern region
p. H	7	7.04	6.74
Electrical Conductivity	0.19	0.16	0.18
Organic Carbon	1.07	0.91	1.21
Nitrogen	101	96.7	95.8
Phosphorous	10.06	9.19	8.59
Potassium	154.64	144.66	160
Mean	45.7	43.11	45.42
Values are expressed as means			
Bacteria	50.33	47.93	48.21
Fungi	7.3	6.3	5
Azotobacter	17.86	16.76	17.03
Azospirillum	16.06	16.11	14.08
Phosphorous Solubilizing Bacteria	13.91	14.11	12.65
Actinomycetes	10.73	10.8	9.9
Mean	19.36	18.66	17.81

Values are expressed as means

5. Discussion

1) pH:

The pH of the soil was found highest i,e. slightly alkaline in Central region followed by Northern region of Kashmir and showed a decreasing trend throughout the study period. This can be related to the heavy rainfall, increased organic carbon content, highest PSB, Actinomycetes, Azospirillum, Fungal and Bacterial population prevailing in the region than other regions of Kashmir (Gupta, *et al*., 1980). Further, the prevailing work of Tate & Terry, 1980, also concluded that moisture and organic matter influence microbial population in soil. The increased Bacterial and Fungal population in the region may be due to the highest pH of the soil (Fozia, *et al*., 2015) because most of the microbes prefer neutral to slightly alkaline pH besides favourable moisture, temperature and organic carbon in the soil.

2) Electrical Conductivity:

Northern region followed by Southern region showed themaximum electrical conductivity values. The maximum electrical conductivity values may increase the soil microbial communities in theregion, which is supported by the findings of Min, *et al*., 2016. The reason could be due to the highest content of organic matter, pH., which increases the population of Azotobacter, Azospirillum in the soil and affects the soil processes including increased Nitrogen mineralization (being highest in the region). This is in conformity with the findings of Tiwari *et al*. (1999) and Bashan *et al*. (1995) who reported that organic matter and Nitrogen content had a positive relationship with the soil Microflora.

3) Organic Carbon:

Southern and Northern regions of Kashmir were statistically significant in case of Organic Carbon content of soil as compared to the Central region of Kashmir. Soils with high Organic Carbon usually have higher microbial population which probably upon decomposition of soil Organic matter plays a crucial role in Carbon and Nitrogen mineralization (Davidson, *et al*, 2006). However, in these regions, the highest population of Azotobacter provided a positive correlation with the soil Organic Carbon, Nitrogen and Potassium content for being the highest in the regions. This is in conformity with the findings of Saksena, 1955.

4) Nitrogen:

The highest Nitrogen content was observed in Northern region of Mulberry growing soils of Kashmir. This may be due to the highest content of Organic Carbon, pH., Electrical Conductivity and Phosphorus content of the region which consequently led to the increase in the population of bacteria, fungi, Azotobacter, Azospirillum and Actinomycetes in the soil. The results are in collaboration with the findings of Pereira, *et al*.2013 who reported the significant relationship between the soil chemical and microbial properties.

5) Phosphorus:

Soil Phosphorus was significantly highest in the Northern region of mulberry soils than the other regions of Kashmir. The variations in the Phosphorus content of soil may be attributed to the adequate moisture, pH., Organic Carbon, Nitrogen besides the increased population of microorganisms (i,e. bacteria, fungi, *Azotobacter*) which during the study were found significantly higher in the Northern region. Perrot, *et al*, (1990) also observed the changes in microbial population with phosphorus mineralization and mineralization, in organic matter rich Pastoral soils.

6) Potassium:

Potassium content was maximum in the Southern region as compared to other regions of Kashmir. This may be because of the highest population of *Azotobacter* in the region, possibly due to the increased Organic carbon content and electrical conductivity in the soils of the region. This is in accordance with the findings of Chauhan, 2001 who reported the positive correlation between organic matter and available Potassium in the soil.

6. Conclusion

The findings of the study shed light on the: -

- Soil microbial ecology of mulberry growing soils which should be helpful for devising effective management strategies to enhance soil microbial diversity and improving cocoon crop productivity.
- Applications of inputs and pruning in a particular region have positive impact on the chemical properties of soils. The mulberry leaf of Northern region being rich in nutrients must be exploited for quality cocoon/silk production.
- Soils of South Kashmir being deficient in nutrients must be supplied with additional amounts of inputs (esp. of Nitrogenous and Phosphatic origin).
- Despite the heterogeneity of various regions (soils), the bacterial populations of the intensively cultivated mulberry gardens were more influenced by p. H., E. C & N content of the soils

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