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Suraksha Chanotra
P.G. Department of Sericulture, Poonch Campus, University of Jammu and Department of Zoology, University of Jammu, Jammu and Kashmir, India

Nirmal Singh
P.G. Department of Sericulture, Poonch Campus, University of Jammu and Department of Zoology, University of Jammu, Jammu and Kashmir, India

Corresponding Author:
Suraksha Chanotra
P.G. Department of Sericulture, Poonch Campus, University of Jammu and Department of Zoology, University of Jammu, Jammu and Kashmir, India

Soil analysis of Poonch campus site Dingale Janngar prior to the establishment of mulberry garden

Suraksha Chanotra and Nirmal Singh

Abstract
Mulberry (*Morus* spp.) is a hardy plant found globally in almost all types of agroclimates extending from tropical to temperate conditions. In India, Mulberry is mainly cultivated for sericulture for feeding silkworms. Soil for mulberry should be deep, fertile, porous, well drained and with good water holding capacity. The present investigation was conducted at Poonch campus site Dingale Janngar, University of Jammu before the establishment of mulberry garden in order to know the status of soil. Physical and Chemical analysis of soil was conducted to know about the soil health. Under physical parameters, water holding capacity of the present soil sample was recorded as 17 per cent and it possesses clay 14.48 per cent, silt 25.34 per cent and sand 60.08 per cent. Under chemical analysis, available nitrogen in the sample was recorded as 500.4 kg/hc, available phosphorous as 24.0 kg/hc and the available potassium in the sample was found to be 38.2kg/hc. Thus it was concluded from current investigation that the present status of soil health in Poonch region is good and is suited for mulberry cultivation as the major nutrients i.e. NPK are present in good amount and the farmers don't need to add more fertilizers. They can obtain a good crop by applying only a small amount of fertilizers particularly the potash fertilizers and can achieve a handsome income by adopting sericulture.

Keywords: Mulberry, soil, analysis, fertilizers, NPK

Introduction
Mulberry (*Morus* spp.) is a hardy plant found globally in almost all types of agroclimates extending from tropical to temperate conditions, having the ability to grow and flourish under varied soil types. In India, mulberry is mainly cultivated for sericulture purpose for feeding the mulberry silkworm *Bombyx mori* L. and other multipurpose uses including the medical ones are also tried. Mulberry can be grown in varied soil types and has the ability to survive under hard conditions as well. In Jammu and Kashmir mulberry is available on road sides, bund sides, river sides and boarders of agricultural fields etc. as a result, mulberry is largely grown in nutrient deficient systems which hinders the quality and quantity of mulberry leaves. Since it forms the sole food material for silkworm so there is a need to pay more attention towards the improvement of mulberry and the very first step for successful sericulture lies with the soil health which decides the growth of plant and ultimately the silk production. Soil structure for mulberry cultivation must be sufficiently porous to supply air and water to the root zone. Soil should be deep, fertile, porous, well drained and with good water holding capacity. Loamy, clayey loamy or sandy loamy soils are the best for mulberry cultivation. Although it can withstand wide range of soil acidity and alkinity but the optimum soil for mulberry should be slightly acidic with a pH ranging from 6.2 to 6.8, though the level of tolerance ranges from 5.0 to 9.0 pH.

Material and Methods
Locale of the study
The present study was conducted at P.G. Department of Sericulture Poonch campus, University of Jammu prior to the establishment of mulberry garden in order to know the status of soil. Before collection and analysis of soil it is important to know the right time for soil analysis and the most important time to have the soil to be analyzed is before planting, so that necessary nutrients can be added and mixed properly into the soil. This analysis is especially important in acidic soils, which requires lime for reclamation. It is recommended that lime application should be done several months before planting as it reacts slowly and takes longer period for reclamation of problematic soil.

Collection of soil sample

In present investigation, soil sample was collected from the field selected for establishment of mulberry garden. Each sample comprised of subsamples taken from 15-20 different locations within the sampling area. The samples were taken from 6 to 8 inches deep pits, mixed thoroughly in a clean container, transferred to plastic zipper bags and prepared for analysis by following various processes including drying, sieving, grinding, mixing and storing. Physical and chemical parameters of soil sample were analyzed and observations were pooled.

Results

Physical Analysis

Soil physics is the interpretation of various soil phenomena in relation to physical parameters. The physical properties of the soil are closely related to its chemical and biological properties. As plants require moisture, temperature and air for their growth and since the soil is the medium for growth of the plants, their influence will be governed by physical forces related to them. Various physical parameters studied in current investigation are summarized below:

Soil color

Soil color is used in soil classification and indicates soil moisture and air relationships. Soil color also indicates the organic matter content and drainage conditions. Organic matter gives all shades of dark color, depending upon the stages of its decomposition. Depending upon the proportion of the minerals; the color of the soil varies from faint yellow to bright red. Color of the present soil sample was observed as dark brown indicating the presence of essential minerals and ions.

Soil Moisture

Plants absorb nutrients from the soil in dissolved state and sufficient moisture is required for utilizing the fertility of the soil. Moisture is an essential component of the soil, since it forms the medium for chemical reactions taking place in the soil for translocation of plant nutrients and maintaining the turbidity of the cells. Analysis of present soil sample indicated that the water holding capacity of the present soil sample was quite good and was recorded as 17 per cent.

Soil Texture

Soil texture is the relative amount of sand, silt and clay present in the soil. The proportion of each of them determines the behavior and the fertility to a greater extent. The present study indicated that the soil sample collected from Poonch campus possesses clay 14.48 percent, silt 25.34 per cent and sand 60.08 per cent.

Chemical Analysis

The percentage of different minerals in a soil is an index of its fertility. Soil fertility refers the capacity of the soil to supply plant nutrients in available form to the plants. There are two types of mineral nutrients present in the soil i.e. Macro-nutrients and Micro-nutrients.

Macro-Nutrient

Nitrogen

Nitrogen constitutes an important element in the composition of the plant and accounts for about 1 to 4 per cent of the dry weight of the plant. It is an important constituent of all proteins, enzymes, chlorophyll, vitamins, hormones and nucleic acids. Total nitrogen does not indicate plant available N and is not the sum of NH4-N + NO3-N. Total N is not used for fertilizer recommendations. The critical level in the soil below which deficiency symptoms occurs is 18 lb/acre if nitrogen is present in the form of nitrate and 65 lb/acre if it is present in the form of ammonia. Only 1 to 4 per cent of this total N becomes plant available converts via microbial activity from organic form to inorganic form during a growing season. The present study revealed that available nitrogen present in the sample was 500.4 kg/hc which is sufficient for mulberry cultivation.

Phosphorous

Phosphorous is a component of nucleic acid, protein and phospholipids. It is necessary for all metabolic activities. Phosphorus fertilizer recommendations are based on a documented relationship between crop yield and extractable soil test phosphorus. Phosphorus soil tests are an index of P availability (low, medium, high, excess). Phosphorus is relatively immobile in soil. The phosphorus application rate necessary to correct P deficiencies varies depending on soil properties and crop grown. The minimum level of phosphorous required for mulberry growth is 50 to 65 lb/acre. In the present sample available phosphorous was found to be 24.0 kg/hc.

Potassium

It is highly mobile and moves up in the plant through xylem and moves down through phloem. It doesn't form any structural component of the plant, but exists in the Free State as a cation. The element has some well defined functions like, regulation of the stomatal closure mechanism, photosynthesis, and cell hydration, synthesis of carbohydrates and protein and catalyzing nitrate reduction. Excessive soil potassium levels can result in elevated K levels in grass forage crops, which may be detrimental to animal health. Conversely, very low soil test K levels can reduce plant growth. The available potassium in the sample was recorded as 38.2kg/hc.

Sulphur

This element is necessary for the synthesis of some amino acids, co-enzymes and vitamins and also for the formation of chlorophyll. Plants absorb sulfur in the sulfate form. Irrigation water may contain significant amounts of sulfate-sulfur. Plant analysis, especially a nitrogen-sulfur (N:S) ratio, is useful for diagnosing a sulfur deficiency. The available sulphur in the sample was recorded to be 24.5 kg/hc.

Table 1: Table showing the status of macro-nutrients in the present sample of soil

S.no	Name of the nutrient	Major nutrients available	Range of nutrient		
			Low *	Medium *	High *
1.	Nitrogen	500.4 kg/hc	<280kg/hc	280 to 560 kg/hc	>560 kg/hc
2.	Phosphorous	24.0 kg/hc	<10 kg/hc	10 to 25 kg/hc	>25 kg/hc
3.	Potassium	38.2 kg/hc	<108 kg/hc	108 to 280 kg/hc	>280 kg/hc
4.	Sulphur	24.5 kg/hc	<20 kg/hc	20 to 40 kg/hc	>40 kg/hc

*Data source: - RSRS Miran Sahib Jammu

This table shows that present soil sample contains Nitrogen 500.4 kg/hc which falls in the category of medium level that means we don't need to add any more nitrogenous fertilizers to our soil. In case of phosphorous present sample contains 24.0 kg/hc of Phosphorous that again falls in the medium level which is good for mulberry. Whereas potassium was recorded as 38.2 kg/hc which indicted deficiency of potassium content and potash fertilizers should be added as per need @ 75 kg/hc. Similarly it contains Sulphur 24.5 kg/hc which indicated moderate level and is considered good for mulberry.

Micro-Nutrients

In addition to these macronutrients, some micronutrients were also analyzed which were recorded as:

Zinc

A zinc soil test above 1.5 ppm using the DTPA extraction method is sufficient for most crops. Many of the seasonal crops, deciduous fruit trees and mulberry as well are sensitive to low levels of soil test Zn. Fertilizer applications with zinc sulfate are typically 5 to 15 lb Zn per acre. Available zinc in the present soil sample was recorded as 1.86 ppm.

Iron

Soil testing for iron is not recommended. Most test methods do not discern between forms of iron and therefore have little meaning for plant nutrition. Iron deficiencies are often associated with plants adapted to acidic soil with an unsuitably high pH. Acidifying the soil with elemental sulfur usually will correct Fe deficiency for plants. Iron salts (such as iron sulfate) applied to alkaline soil do not remain plant available for long enough to be an effective plant nutrient source. In current investigation available iron was recorded as 1.78 ppm.

Manganese

Adequate soil test Mn varies with crop. Soil test values between 1 and 5 ppm using the DTPA extraction method are usually sufficient. Manganese deficiencies generally occur only when soil pH is 8.0 or above. Diagnosis of either Mn deficiency or toxicity should use soil pH and tissue Mn concentration in combination with soil test Mn and in current experiment value of available Mn was recorded as 4.10 ppm.

Copper

Copper values above 0.6 ppm using the DTPA extraction method are sufficient. Copper deficiencies are extremely rare, regardless of soil test results. Moreover, routine copper application to mineral soil can cause copper toxicity. Available copper in present study was found to be 1.04 ppm

Table 2: Table showing the status of micro-nutrients in the present sample of soil

S.no	Name of the nutrient	Minor nutrient available	Range of nutrient		
			Low *	Medium*	High *
1.	Zinc	1.8 ppm	<.6 mg/gm	.6 to 1.2	>1.2
2.	Iron	1.78 ppm	<.5 mg/gm	------	-----
3.	Manganese	4.10 ppm	<3 mg/gm	------	-----
4.	Copper	1.04 ppm	<.2 mg/gm	------	-----

*Data source: - RSRS Miran Sahib Jammu

Soil pH

Soil pH expresses soil acidity. Most crops grow best when the soil pH is between 6.0 and 8.2. pH of soil affects the availability of different plant nutrient in various ways. The maximum availability of all the major nutrients is in pH range of 5-7.5. However, the availability of micronutrients viz; Fe, Mn, Zn, Cu, B, Mo and Cl are more in acidic range. The ideal range of soil pH is 6.2 to 6.8. Soil amendments may be used to the soil to get required pH. The pH of present soil sample is recorded to be 7.01 i.e. neutral.

The range of pH and its reaction on soil is given below:-

Soil reaction	pH
Strongly acidic	< 5.1
Moderately acidic	5.2–6.0
Slightly acidic	6.1–6.5
Neutral	6.6–7.3
Moderately alkaline	7.4–8.4
Strongly alkaline	> 8.5

Soil pH can be increased by liming, the application of calcium carbonate (limestone). The soil pH test indicates if lime is needed. The lime requirement test determines how much lime is needed.

Electric Conductivity

Soil electric conductivity (EC) is a measure of the amount of salts in soil (salinity of soil). It is an important indicator of soil health. EC levels can serve as an indirect indicator of water soluble nutrient available for plant uptake such as nitrate-N (USDA, NRCS; Soil Electrical Conductivity Soil quality kit –Guides for Educators). The Electric Conductivity (EC) of the present sample fond to be 0.730 dsm-1.The range of EC and its extent of suitability for mulberry is shown below:

The range of EC and its extent of suitability for mulberry is shown below:

Electrical conductivity EC (ds/m)	Extent of suitability
< 1.0	Suitable for mulberry.
2.0 to 3.0	Critical for rooting of mulberry.
>3	Injurious to mulberry.

Discussion and Conclusion

From this investigation it can be concluded that the soil of Poonch region is good enough for mulberry cultivation as all the macronutrients required for growth and development of mulberry plant are reported to be present in sufficient quantity. The results of current investigation confirm the findings of Rathore *et al.*, 2011 [4], who suggested the cultivation of mulberry under temperate conditions of Jammu and Kashmir. It doesn't require application of any additional fertilizers. Singh *et al.*, 2016 [5], reported the similar findings and suggested mulberry cultivation with minimum addition of fertilizers. The only component lacking is potassium which can be reclaimed by adding little amount of potash fertilizers.

Thus farmers of Poonch region can achieve a very good income by adopting sericulture there without the application of much fertilizer inputs.

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