PHYSICAL AND CHEMICAL EVALUATION OF THE MORELS HABITAT IN UTROR VALLEY KALAM DISTRICT SWAT KHYBER PAKHTUNKHWA

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ABSTRACT

The study was under taken as a Research Project for partial fulfillment of the degree of M.Sc Forestry Extension from Allam Iqbal Open University Islamabad. Prior to conserve Morels, studying physical and chemical parameters of Morels habitat are one of the prerequisites. The Morels habitat in Utror valley Kalam was studied with focus on soil where Morels grow, ten (10) plots were selected randomly, soil samples were collected by the usual procedure from the selected plots of the study area i.e. from 0- 90 cm depth. The soil samples were air dried grinded and packed tightly in plastic bottles and labeled. These samples were then used for further investigation. The soil layer, cover, depth, water holding capacity texture, pH, total organic matter, calcium carbonate (CaCO3), percent nitrogen (%N), phosphorus (%P) and potassium (%K) were determined in the soil of selected area through recommended analytical procedures. We found that the soil of Utror valley Kalam Swat is feasible for the growth of Morels besides recommendations for *ex-situe* conservation of Morels.

LOCATION OF THE STUDY AREA

Geographically, Swat lies from 34°-34` to 35°-55` North latitudes and 72°-08` to 72°-50` East longitudes with an area of 5337 km^2. The District is bounded in North by Ghizer district of Northern Areas, the east by Shangla and Kohistan, on the South by Buner district and Malakand Protected Area and on the West by the lower and upper Dir Districts.

The present work is confined to Utror valley Kalam, Swat, located at the extreme north of Swat District, NWFP, Pakistan Utror valley is located from 35°-18` to 35°-52` North- latitudes and 72°-12` to 72°-33` East longitudes over the globe. It is bounded in the east by Ushu valley, in the Southeast by Kalam, in the South by Bahrain and in the west by Chitral. Utror proper is the main settlement of the valley with total area of 38733 hectare. The Utror River is one of the main tributary that form river Swat at Kalam.

INTRODUCTION TO THE STUDY AREA

Topographically, Swat is a mountainous area and can be divided into two regions i.e., Swat-Kohistan and Swat Proper. Swat-Kohistan is the mountainous country on the upper reaches of the Swat river up to Ain in the south. The whole area south of Ain is Swat Proper, which can be further subdivided into Bar (upper

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Swat) and Kuz (lower Swat). The elevation of Swat valley at the southern boundaries of the District is over 600 meters and rises rapidly towards the north. There are several mountain peaks ranging from 4500 to over 6000 meters above the sea level. In Swat valley there are numerous picturesque spots with lush green and thickly forested mountains, some of them permanently under snow. The earth is a cold, globular, solid planet, spins on its axis and revolves around the sun at a constant distance. The solid part of the earth is called lithosphere, including three main layers called crust mantle, outer and inner core. The crust mantle is covered by soil and is an important ecological factor. Soil is the loose, friable, unconsolidated top layer of earth's crust and organic components, which are formed by the decay of dead bodies of plants or animals or through metabolic actions of living organisms and mixture of minerals called mineral particles. Most of these particles originate from the degradation of rocks. Some start off from the residues of plants or animals (decaying leaves, pieces of bone, etc.), called organic matter. These soil particles have spaces called pores. When the soil is dry, the pores are filled with air and after irrigation or rainfall these pores are filled with water (Trivedi, 1992). The soil profile can be classified in to three layers. The first layer is called plough layer (20 to 30 cm thick) and is rich in organic matter mainly live roots having dark brown to black in color. The second layer is lighter grey in color and is the deep plough layer, contains much less organic matter and live roots. The third layer is known as subsoil layer, containing organic matter or live roots. This layer is not very significant for plant growth because only some roots will get to it. The fourth one is called parent rock layer, consists of rock called parent material (Nyle, 1974). Soil texture is composed of gravel particles between 2 and 64 mm in diameter. Gravel particles are broken down into sand (2mm in diameter), silt (1/16 mm in diameter) clay (1/256 mm in diameter). In coarse textured soils, sand is predominant (sandy soils). In medium textured soils, silt is predominant (loamy soils) while in fine textured soils; clay is predominant (clayey). Soil structure refers to the grouping of soil particles (sand, silt, clay, organic matter and fertilizers) into porous compounds called aggregates, which are separated by pores and cracks. Granular, blocky, prismatic and massive structure blocks the entrance of water making seed germination in to poor aeration. On the other hand in granular structure, the water enters easily and the seed germination is facilitated. In a prismatic structure, movement of the water in the soil is predominantly vertical and therefore the supply of water to the plant roots is usually poor. Unlike texture, soil structure is not permanent. By means of cultivation practices (ploughing, ridging, etc.), the farmer tries to obtain a granular topsoil structure for his fields (Trivedi, 1992, Nyle, 1974).Nutrients for healthy plant growth are divided into three categories, primary, secondary and micronutrients. Nitrogen (N), phosphorus (P) and potassium (K) are primary nutrients, which are needed, in fairly large quantities compared to the other plant nutrients. Calcium (Ca), magnesium (Mg) and sulfur (S) are secondary nutrients, which are required by the plant in lesser quantities but are no less essential for good plant growth than the primary nutrients. Zinc (Zn) and manganese (Mn) etc. are micronutrients, which are required by the plant in very small amounts. Most secondary and micronutrient deficiencies are easily corrected by keeping the soil at the optimum pH value (Stevenson, 1965). Earlier research workers have found primary, secondary and micronutrients in soil (Lindsay, 1979. Bolan, 1991. Marschner et.al., 1994. Robbins et.al., 1997. Curtin et.al., 2001. Ricardo et.al., 2000. Robbins et.al., 1999. Antonio, 2000. Barrow, 2000. Holford, 1997. Abbas et.al., 1998. Barrow, 1999. Tiller et al., 1972, Maguire, et al., 2000. Sharply et.al., 1989. Chen et.al., 1996. Gaszcyk et.al., 1995. Kong et.al., 1966). The soil of Swat valley generally consists of residual as well as transported soils. Along the step crest and slopes, and in the broken hill country, shallow residual soil has developed. At the piedmont zone near foothill, these soils are usually strongly calcareous, with acceptable quantity of organic contents excluding some areas having sufficient level of organic matter. According, to a survey conducted by the Department of Geology, University of Peshawar Pakistan, the major geological formations in the area are the Swat granites, Kalam volcanic and hornblendic group. Soils are fairly deep on the moderately steep slopes of the southern exposures. Collectively the soil is capable of supporting a vigorous and good coniferous crop (W. P Kalam Forest 1987-88 to 2001-2002).

METHODOLOGY

Physical and Chemical Evaluation of Habitat

The soil layer, cover, depth, water holding capacity texture, pH, total organic matter, calcium carbonate ($CaCO_3$), percent nitrogen (%N), phosphorus (%P) and potassium (%K) were determined in the soil of selected area through recommended analytical procedures.

Collection of soil samples

Soil samples were collected by the usual procedure from the selected plots of the study area i.e. from 0- 90 cm depth. The soil samples were obtained from plots 1-10.

Preparation of the soil Samples

The soil samples were air dried ground and sieved through 53m sieve. The samples were stopper tightly in plastic bottles and labeled. These samples were then used for further investigation.

PHYSICAL PARAMETERS

pH of the Soil

pH of the soil samples were measured with the help of pH meter (model: Hanna HI 8418).

Soil Texture

Texture was determined by Bouyocous Hydrometer method as described by Moodie *et.al*., 1954.

CHEMICAL PARAMETERS

Determination of Organic Matters

Procedure

One gram of soil was treated with 10 ml of 1N $K_2Cr_2O_7$ and 20 ml of concentrated H_2SO_4 were added. After cooling first 200ml of distilled water were added followed by 25 ml of 0.5N Fe $(NH_4)_2(SO_4)_2$. 6 H_2O and titrated against 0.5N $KMnO_4$ solution. A blank titration was also run as given by Piper modified method.

Calculation

% age of organic matter = ml of $KMnO_4$ used for samples – ml of $KMnO_4$ used for blank × 0.5× 0.69/ weight of the soil sample.

Determination of Lime Contents

Procedure:

Ten gram of soil was taken and lime was decomposed by treating with excess of 0.5 N HCl. The excess of HCl was titrated against 0.25N NaOH Using Phenolphthalein as an indicator (Piper.C.S.1955).

Calculations

Milli equivalent of HCl added – milli equivalent of NaOH used × 5.0/ weight of the soil sample.

Total Macro-Nutrients

Preparation of Soil Extract

0.5g of the soil samples were taken in a platinum crucible. The samples were moistened with a few drops of double distilled water. 5ml of 48% HF and 0.5ml of 70% $HClO_4$ were added. The crucible was placed on a sand bath and heated to dryness at 250 oC, 5ml of Conc. HCL was added and the crucible was heated to dissolve the residue. The solution obtained war transferred into 250ml flask using 20ml of 6N HCl for washing as given in Black and Jackson method. The solution was diluted to the mark with double distilled water and used for the determination of total macronutrients such as calcium, magnesium, potassium, and sodium by atomic absorption spectrophotometer.

Determination of Total Nitrogen

Reagents

H_2SO_4 concentrated.

0.1N H_2SO_4

50% solution of NaOH.

Mixed indicator.

Salt mixture: A salt mixture containing 790g of K_2SO_4 and 100g of ferrous sulphate and 100g of $CuSO_4$. $5H_2O$ were prepared.

Procedure

Digestion:

0.2-0.5g of soil was taken in a semi-micro Kjeldal flask. 5-7 ml of concentrated H_2SO_4 was added. 2g of salt mixture were added. The contents of the flask were heated until the solution become clear, the digestion was continued for thirty minutes more to ensure the complete digestion.

Distillation

The digestion mixture was allowed to cool, and then 25ml of distilled water were added followed by 5ml of 50% NaOH solution. Antibumping chips were also added and then solution distilled. The distillate was received in 25ml flask containing 10ml of 0.1N Standard NaOH, using mixed indicator.

Calculations

%age of N = (Acid used × N of acid)-(Base used × N of base) × 1.4 / weight of sample taken.

f): Determination of Total Phosphorus

Procedure

Water-soluble phosphorus was measured in a 1:27 (weight/volume) ratio of soil/water according to a modification of Sissingh (1971) procedure. Briefly, 2 ml of distilled water were added to 1 g of dry soil for an initial contact time for 22 hours. 25 ml of distilled water were added and the mixture was shaken for one hour. The Phosphorus was determined by colorimetric method by the molybdenum blue method (Murphy & Riley, 1962, Beauchemin et al., 2000).

RESULTS AND DISCUSSION

Soil pH

It is evident from the data (Table 3) the soil samples have pH is in the range of 6.1 to 7.0 which shows that the soil of study area are slightly acidic to slight alkaline. The highest pH value was found for plot – 6, which may be due to the high lime content (Table 10) while the lowest pH was noted in plot 2, 3 and 4, and may be due to the low level of time, phosphorous contents and mineralization of organic matters (Curtin & Smellier, 1995). The pH value of a soil influenced by the kinds of parent materials from which the soil was formed, soils developed from basic rocks generally have higher pH values then those formed from acid rocks. Rainfall also affects the soil pH. Water passing through the soil leaches basic nutrients, such as calcium and magnesium from the soil and is replaced by acidic elements such as aluminum and iron. For this reason soils formed under light rainfall conditions are more acidic then those formed under arid conditions. The soil pH may influence the nutrients absorption and plant growth through direct effect of hydrogen ion, indirectly through its influence on nutrients availability and the presence of toxic ions. In most soil the latter is great importance for instance, several essential elements like Fe, Mn and Zn tend to become less available as the pH of the soil is raised from 5.0-7.5 or 8.0 while Mo is available at higher pH level. Phosphorus is never readily soluble in the soil, but it seems to be held tenacity in a pH range centering around 6.5, so the plants extract the phosphorus from the soil with least difficulty. At pH value below about 5.0, aluminum, iron and manganese are often soluble in sufficient quantities to the growth of some plants. At very high pH values, the bicarbonates ion is some times present in sufficient quantities to interfere with the normal uptake of other ions and thus is detrimental to optimum growth and fertility of soil. (Brandy, 1974)

As the climate of the study area is dry temperate with the bulk of rainfall, therefore the pH of the study area is moderate and thus shows high potential towards the growth of morels.

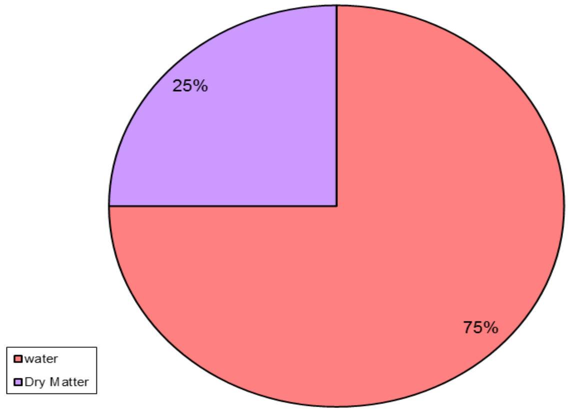

Fig: Plot Showing the water holding capacity and dry Matters.

Water Holding Capacity

The Table 4, shows the concentration of water holding capacity of morel habited of Utror valley Kalam District Swat was in the range of 21.8 to 29.3%. The water enter the soil through rain or irrigation, displace the soil air and the soil surface wet up i.e. the water contents are uniformly distribute over the surface, covering the pores. The continuous exposure of the soil surface to water will result into downward movement and the soil is reached to the saturation. The dry mineral soil usually adsorb and hold from 1/5th to 2/5th its weight of water and organic soil will retain 2 to 4 times its dry weight of moisture. The humus peat soil has a much greater water holding capacity. Such materials can hold water to the extent of 12, 15 or even 20 times their dry Wight. The humus peat soil at optimum moisture will supply only slightly more water to plants than a comparable mineral soil (Brandy, 1974). The soil of the study area is humid therefore it provides more water contents to the body of morel, keeping them fresh and turgid as can be seen from the plot shown above.

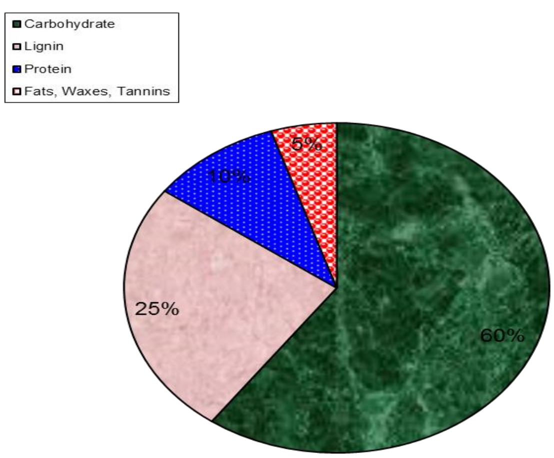

Fig: Plot Showing the Type of Compounds of Plant Material Added to Soil After Decay.

Table 1. Textural Classification of Utror Valley Kalam, Soil (Morel habitat) Swat District.

S.No	Plots	Textural Classes					
		TC1	TC2	TC3	TC4	TC5	TCM
1	1	HP	HP	HP	HP	HP	HP
2	2	HP	HP	HP	HP	HP	HP
3	3	HP	HP	HP	HP	HP	HP
4	4	HP	HP	HP	HP	HP	HP
5	5	SCL	SCL	SCL	SCL	SCL	SCL
6	6	SCL	SCL	SCL	SCL	SCL	SCL
7	7	HP	HP	HP	HP	HP	HP
8	8	HP	HP	HP	HP	HP	HP
9	9	HP	HP	HP	HP	HP	HP
10	10	HP	HP	HP	HP	HP	HP

Table 2. Soil Temperature of Utror Valley Kalam, (Morel habitat) Swat District

S.No	Plots	Temperature (°C)						Statistics	
		T1	T2	T3	T4	T5	TM	SD	V
1	1	3.4	3.8	3.6	3.5	3.2	3.5	0.200	0.050
2	2	3.0	3.0	3.0	3.0	3.0	3.0	0.000	0.000
3	3	3.6	3.8	3.7	3.6	3.5	4.3	0.290	0.013
4	4	3.2	3.1	3.0	3.3	3.4	3.2	0.141	0.017
5	5	3.0	3.0	3.0	3.0	3.0	3.0	0.000	0.000
6	6	3.3	3.3	3.2	3.4	3.5	3.34	0.100	0.013
7	7	5.0	5.1	5.2	5.0	5.3	5.1	0.083	0.037
8	8	3.0	3.2	3.4	3.3	3.5	3.2	0.200	0.037
9	9	3.1	3.2	3.2	3.5	3.6	3.3	0.216	0.047
10	10	3.0	3.0	3.0	3.1	3.3	3.0	0.130	0.017

Table-3: Soil pH of Utror Valley Kalam, (Morel Habitat) Swat District.

S.No	Plots	pH						Statistics	
		pH1	pH2	pH3	pH4	pH5	pHM	SD	V
1	1	6.5	6.3	6.2	6.1	6.2	6.2	0.151	0.023
2	2	6.3	6.1	6.0	6.2	6.0	6.1	0.117	0.17
3	3	6.0	6.2	6.1	6.4	6.0	6.1	0.167	0.028
4	4	6.0	6.1	5.98	6.2	6.4	6.1	0.171	0.030
5	5	6.6	6.8	6.8	6.5	6.2	6.5	0.248	0.062
6	6	7.3	7.0	7.1	6.98	6.99	7.0	0.135	0.0183
7	7	6.7	6.8	6.6	6.5	6.2	6.5	0.23	0.053
8	8	6.5	6.3	6.8	6.1	6.0	6.3	0.321	0.103
9	9	6.6	6.0	6.2	6.2	6.4	6.3	0.228	0.052
10	10	6.3	6.4	6.5	6.2	6.1	6.3	0.158	0.025

Table 4. Water Holding Capacity of Utror Valley Kalam, Soil (Morel habitat) Swat District.

S.No	Plots	Water Holding Capacity (%)						Statistics	
		WH1	WH2	WH3	WH4	WH5	WHM	SD	V
1	1	28.0	28.9	28.5	30.2	31.2	29.3	1.31	1.72
2	2	29.0	28.5	28.0	29.3	28.2	28.6	0.50	0.295
3	3	28.5	30.2	29.5	28.3	28.0	28.9	1.00	0.845
4	4	27.0	27.1	27.5	26.5	26.8	26.9	0.452	0.137
5	5	27.2	27.3	27.4	27.5	27.9	27.4	0.252	0.073
6	6	22.0	23.0	22.5	21.8	22.2	22.3	2.32	0.370
7	7	21.8	21.9	22.0	21.8	21.5	21.8	2.50	0.035
8	8	27.5	27.3	27.4	27.5	27.8	27.5	0.327	0.035
9	9	27.3	27.2	27.0	27.1	27.4	27.2	0.318	0.020
10	10	28.3	28.4	28.5	28.5	28.8	28.5	0.234	0.230

Organic Matters

Organic matters influence both physical and chemical properties of soil, and mainly accounts of the cation exchange capacity of soil, which in turn is responsible for the stability of soil aggregates. Furthermore, it supplies energy and body building constituents for the microorganisms. The original source of soil organic matter is plant tissue these materials are decomposed and digested by soil organism and the two-major kinds of organic compounds tend to remain in the soil i.e. resistant compounds of high plants origin such as oils, fats, waxes and lignin and new compounds such as polysaccharides and polyuronides. The lignin are partially oxidized and thereby increasing their reactivity. So these two forms of organic compounds provide a basic network for humus soil. Some nitrogenous compounds carry sulphur and the hetrotropic organisms are simplified to some extent and then by the action of autotrophic bacteria to sulphate and remain there and maintain the acidity and basicity of soil. (Brandy N. 1974).

- [HS] + 2O2 ® SO4-2 + H+ + Energy

Some organic compounds even contribute to the weathering of mineral matters. The process by which soil is formed e.g. C2O4-2, oxalate ion produced as a soil fungi; occur in soil as the calcium salts whwellite and weddelite. Oxalate in soil water dissolves minerals, thus speeding the weathering process and increasing the availability of nutrient ion species. This weathering process involves the oxalate complixation (formation of iron complex) of iron or aluminum in minerals as represented by the following reaction.

3 H+ + M (OH)3(S) + 2 CaC2 (s) ® M(C2O4)2- + 2 Ca+2 + (aq) + 3 H2O

In the above reaction M. represents Al or Fe. Some soil fungi produce citric acid and other chelating organic acid, which react with silicate minerals and release potassium and other nutrient metal ions held by these minerals. The strong chelating agent 2-ketogluconic acid is produced by some soil bacteria which release the phosphate from insoluble phosphate compound to soluble form. The accumulation of organic mater in soil is strongly influenced by temperature and by the availability of oxygen, since the rate of biodegradation decreases with decreasing temperature; organic matter does not degrade rapidly in colder climates and tends to build up in soil. Organic contents may reach to 90% in areas where the plants grown and decay in soil, saturated with water. (Manalian, 1994). The organic matters in the soil of morels habitat (Utror valley Kalam District Swat) was noted in the range of 6.9 to 11.9 (Table 5). As the concentration of organic matters in the soil of the study area is enough, therefore it shows a high fertility towards the growth of morels. The following plot shows the type of compounds of plant material added to soil in general.

LIME CONTENTS

Soil acidity and the nutritional conditions that accompany, it results when there is a deficiency of adsorbs metallic cations relative to hydrogen. To increase acidity (basicity) the hydrogen must be replaced by metallic cations mainly by adding oxides, hydroxides or carbonates of calcium and magnesium. These compounds are referred to as agricultural limes. Lime contents highly affect the physical, chemical and biological characteristics of soil, e.g. the physical effects include the decomposition of soil organic matter, synthesis of humus and the stimulation of nitrogen fixing bacteria. The chemical effects contain the decrease in the concentration of hydration ions, increase in the concentration of hydroxyl ion, decline in the solubility of iron, aluminum and manganese, increase in the availability of phosphate and molybdates, Increase in the ion exchange of calcium, magnesium and the availability of potassium (increase or decrease depending on condition).

The biological effects accelerate the activity of hetrotropic soil organism. This stimulation not only favours, the formation of humus but also encourages the elimination of certain organic intermediate products that might be toxic to plants. (Brandy – N- 1974). The lime contents in the form of calcium carbonate ($CaCO_3$) were determined in the range of 1.3 to 2.1 in plot 1-10 (Table 6). The highest value was recorded in plot –7 and the lowest value in plot – 4. Therefore, the above stated physical, chemical and biological effects are possible on the soil chemistry of the selected area, which is turn shows a great potential towards the growth of morels.

Percent Nitrogen (%N)

Nitrogen a macronutrient has a pronounced effect on the vegetative growth of plants because it increases the percentage of proteins. In soil nitrogen is available in three major forms such as organic nitrogen associated with the soil humus, ammonium nitrogen fixed by certain clay minerals and soluble inorganic ammonium and nitrate compounds. (Brandy, 1974) in most soils, over 90% of the nitrogen contents is organic; this organic nitrogen is primarily the products of biodegradation of dead plants and animals. It eventually hydrolyzed the ammonium ion, which can oxidize to nitrate ion by the action of bacteria in the soil. Nitrogen bound to soil humus is important in maintaining the soil fertility. As the nitrogen fixing organism ordinarily cannot supply sufficient nitrogen to meet peak demand. In this connection the fertilizers are mainly cover the remaining deficiency. The rate of nitrogen release to plants growth is rapid during the warm-growing season and slow during the winter months (Manahan, 1994). The percent Nitrogen status of the study area can be seen from Table 7. The highest value was recorded in plot – 3 and 9 while the lowest value was in plot No.–4. The growth of morels are in peak in the summer season because of the availability of essential nutrients specially nitrogen in the soil easily.

Table 5. Organic Matters of Utror Valley Kalam, Soil (Morel habitat) Swat District

S.No	Plots	Organic Matters (%)						Statistics	
		OM1	OM2	OM3	OM4	OM5	OMM	SD	V
1	1	10.0	10.9	11.2	11.5	11.0	10.9	0.560	0.317
2	2	11.5	11.8	11.9	11.6	11.9	11.7	0.181	0.033
3	3	10.0	10.5	11.5	11.9	11.2	11.9	0.766	0.587
4	4	10.6	10.8	10.8	10.6	10.2	10.6	0.245	0.060
5	5	10.5	10.5	10.4	10.3	10.4	10.4	0.083	0.007
6	6	6.8	6.9	7.2	7.3	7.2	7.0	0.216	0.047
7	7	6.9	6.3	7.2	7.1	7.0	6.9	0.353	0.125
8	8	11.0	11.5	11.3	11.4	11.2	11.2	0.192	0.037
9	9	11.2	11.2	11.3	11.3	11.2	11.2	0.054	0.003
10	10	11.4	11.2	11.4	11.0	11.2	11.2	0.167	0.028

Table 6. Lime Contents ($CaCO_3$) of Utror Valley Kalam, Soil (Morel habitat) Swat District

S.No	Plots	Lime Contents ($CaCO_3$,mg/L)						Statistics	
		LC1	LC2	LC3	LC4	LC5	LCM	SD	V
1	1	1.5	1.6	1.8	2.2	2.0	1.8	0.286	0.082
2	2	1.8	1.6	1.9	2.0	1.4	1.7	0.240	0.058
3	3	1.7	1.8	1.75	1.65	1.73	1.70	0.056	0.0031
4	4	1.4	1.3	1.35	1.42	1.38	1.30	0.046	0.002
5	5	1.30	1.30	1.40	1.35	1.42	1.35	0.055	0.003
6	6	2.00	2.10	2.20	2.40	2.30	2.20	0.151	0.025
7	7	2.10	2.10	2.10	2.20	2.40	2.10	0.13	0.017
8	8	1.70	1.80	1.90	2.00	2.20	1.90	0.192	0.037
9	9	1.60	1.80	2.00	2.20	2.40	2.00	0.316	0.100
10	10	1.70	1.90	1.80	2.00	2.20	1.90	0.192	0.037

Percent Phosphorous (%P)

The percentage of phosphorus in plant material is relatively low but still it is an essential component of plant. Phosphorus is present in a simple inorganic form before the plants can take it up. In case of phosphorus the utilizable specie is some form of orthophosphate oil. Orthophosphate is mostly available to the plants in pH – values nearly neutrality. Generally in acidic soil orthophosphate ions are precipitated or sorbed by species of Al+3 and Fe+3. In alkaline soil orthophosphate may react with calcium carbonate to form insoluble hydroxyapatite (Manahan, 1994).

2 HPO42- + 6 CaCo3(s) + 2 H2O à Ca5 (PO4)3(OH)(s) + 5 HCO3- + OH-.

The factors which control the accessibility of inorganic soil phosphorus are, soil pH, soluble iron, aluminium and manganese. The presence of iron, aluminium and manganese containing minerals, calcium minerals, amount and decomposition of organic matters and activities of microorganism.

The percent phosphorous status of Utror soil (study area) shows the concentration from 0.66 to 1.16 (Table 8). The lowest value was recorded in plot-2 and highest value in plot-1. All plots show a sufficient quantity of phosphorus therefore the possibilities of morel population in this area are maximum due to a healthy environment. The phosphorus in the soil of various localities has also been reported by earlier research workers (Delgado, 2000, Robbins, et al., 1999, Curtin, 2001).

Percent Potassium (%K)

The potassium is a macronutrient and essential for photosynthesis, starch formation, translocation of sugar and for the development of chlorophyll is available in soil in three general forms i.e. unavailable, readily available and slowly available. Although most of the soil potassium is in the first of these three forms. Relatively high levels of potassium are utilized by soil growing plants. Potassium also plays a key function in the water balance, activation of some enzymes and carbohydrate transformation in the plant body. The exact mechanism that govern the potassium fixation and released is not clear but there are certain factors which influence the fixation of potassium for example, soil colloids, wetting and drying and the presence of lime (Brandy, 1974). The morels yield is generally reduced in potassium deficient soil. The higher the productivity of morels, the more potassium is taken up from the soil. As the quantity of potassium in the soil of the study area is high enough i.e. from 6.2 to 10.54%, therefore it gives a healthy productivity of morels within the area. The percent value of potassium in the soil of study area is shown in Table 9.

Table 7. Percent Nitrogen Status of Utror Valley Kalam, Soil (Morel habitat) Swat District

S.No	Plots	Percent Nitrogen Status						Statistics	
		%N1	%N2	%N3	%N4	%N5	%NM	SD	V
1	1	0.23	0.43	0.53	0.34	0.52	0.41	0.126	0.016
2	2	0.42	0.43	0.45	0.45	0.45	0.44	0.0141	0.0002
3	3	0.53	0.52	0.50	0.51	0.54	0.52	0.0158	0.0003
4	4	0.12	0.14	0.13	0.15	0.16	0.14	0.0158	0.033
5	5	0.23	0.33	0.35	0.36	0.38	0.33	0.058	0.0034
6	6	0.28	0.29	0.31	0.33	0.34	0.31	0.025	0.0007
7	7	0.31	0.34	0.35	0.36	0.31	0.33	0.023	0.0005
8	8	0.42	0.51	0.21	0.35	0.41	0.38	0.110	0.0123
9	9	0.51	0.52	0.53	0.52	0.52	0.52	0.007	0.00005
10	10	0.50	0.45	0.42	0.43	0.43	0.44	0.0311	0.0010

Table 8. Percent Phosphorus Status of Utror Valley Kalam, Soil (Morel habitat) Swat District

S.No	Plots	Percent Phosphorus Status						Statistics	
		%P1	% P2	%P3	%P4	%P5	%PM	SD	V
1	1	1.20	1.30	1.20	0.90	1.20	1.16	0.151	0.02300
2	2	0.80	0.40	0.60	0.80	0.70	0.66	0.167	0.02800
3	3	0.99	0.98	0.98	0.97	0.97	0.97	0.008	0.00007
4	4	0.82	0.83	0.84	0.85	0.87	0.84	0.019	0.00037
5	5	0.72	0.73	0.76	0.75	0.74	0.74	0.016	0.00025
6	6	0.74	0.73	0.72	0.74	0.76	0.73	0.011	0.00013
7	7	0.82	0.80	0.81	0.83	0.84	0.82	0.016	0.00025
8	8	0.83	0.84	0.85	0.85	0.86	0.84	0.11	0.00013
9	9	0.92	0.91	0.93	0.94	0.96	0.93	0.02	0.00037
10	10	0.87	0.88	0.89	0.86	0.85	0.87	0.016	0.00025

Table 9. Percent Potassium Status of Utror Valley Kalam Soil (Morel habitat) District Swat

S.No	Plots	Percent Potassium Status						Statistics	
		%K1	% K2	%K3	%K4	%K5	%KM	SD	V
1	1	10.4	10.6	10.7	10.8	10.2	10.54	0.240	0.058
2	2	8.30	8.40	8.50	8.60	8.30	10.0	0.13	0.017
3	3	9.20	9.30	9.40	9.80	9.90	9.50	0.311	0.097
4	4	10.1	10.2	10.3	10.4	10.3	10.2	0.114	0.013
5	5	9.90	9.90	9.50	9.60	9.70	9.80	0.178	0.032
6	6	8.50	7.50	7.80	7.90	8.20	7.90	0.383	0.147
7	7	7.20	7.50	7.30	7.20	7.40	8.70	0.130	0.0147
8	8	5.20	5.30	5.40	5.20	5.40	5.40	0.100	0.010
9	9	6.20	6.20	6.30	6.40	6.20	6.20	0.090	0.008
10	10	7.10	7.20	7.30	7.30	7.50	7.20	0.150	0.022

RECOMMENDATIONS

Baseline information for the research workers should be provided in the form of books, research journals, magazines and reports about the habitat.

Proper and constant evaluation of the habitat (soil) is necessary for the sustainable growth of Morels.

The soil of Utror valley Kalam is fit for growing of Morels, *Ex-situe* conservation of Morels can be encouraged in Utror valley.

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