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Nutrient screening and its correlation with soil properties of soil samples from Havalbag block of Almora

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Abstract
This experiment target measuring soil properties (pH, EC and OC), nutrient (N, P, K and S) and the correlation study between soil properties and nutrient availability. Six different locations in Havalbag block, Almora district of Uttarakhand, were sampled for soil (0-15cm depth). Nitrogen, Phosphorous, Potassium and Sulphur nutrient in soil were examined using known conventional methods. Available Nitrogen was examined by alkaline $KMnO_4$ method, extractable available Sulphur by $CaCl_2$ method, available Potassium and available phosphorus by Morgan method. The soil pH showed a positive and significant correlation with available Nitrogen. The OC and EC showed a positive correlation with available S for the entire area of study. After analyzing all nutrient indices, the soils under study were found to be high in extractable S and medium in P extractable K and low in and N.

Keywords: Alkaline $KMnO_4$, $CaCl_2$ method, ammonium acetate and Bray's method

1. Introduction
Since the world's soil resources are finite, intensive land use is necessary to meet the need for food and fibre on a global scale. The risks to the soil and ecological health increase with intensive farming on already-existing arable land. Therefore, it is crucial to understand how land use and the board affect soil quality, establish linkages between soil quality from one perspective and rural maintainability, and natural quality (such as water pollution or the influence of global warming) from the other. Differentiating norms for quantitative evaluation of manageability and soil quality serve as the foundation of such utility hookups (Laishram *et al.*, 2012) [1]. Profitability of soil refers to the ability of soil to produce a specific plant or sequence of plants based on a predetermined framework. Food security can be threatened immediately by intensive agriculture practices that decrease soil profitability (Duan *et al*., 2011) [3]. Nutrient management significantly affects the preservation of soil productivity, and the study of soil nutrients is used as a criterion to determine fertilizer recommendations for crops. Because other elements like soil pH, soil temperature, soil moisture, and soil physical environment also affect their availability, the presence of sufficient amounts of essential nutrients in the soil does not guarantee that they are accessible to plants. The bulk of the anti-toxins that are utilized in the fight against disease are found in soil, which also serves as a growing medium. (Mathew *et al.*, 2012) [6]. Due to imbalanced and lacking fertilizer utilization combined with low productivity of different information sources, the response efficiency of substance manure supplements has declined massively under escalated farming. Thus, it is basic to know the nutrient status of soil to get most wanted yield from it. Uttarakhand's soils are brown to grayish brown, acidic to moderately neutral in pH, and highly erodible (Shukla *et al.*, 2013) [9]. Therefore, nutrient status should be evaluated periodically in a region. This study examines soil samples from Havalbag block of Almora district of Uttarakhand and determines how soil properties relate to extractable macronutrients.

2. Materials and Methods
Following soil collection, samples were air-dried in the shade, filtered by 2 mm sieve and properly stored in labelled clean bags. The general soil properties were examined. The soil texture was measured by rapid feel method and soil color was assessed by Munsell color chart. The pH of soil suspension (1:2 water) was determined using a pH meter (Jackson, 1967) [5]. Electrical conductivity meter was used to measure the soluble salts in a 1:2 soil-water solution at 25 °C in dSm^{-1} after 24 hours of incubation.

Organic carbon was measured according to Walkley and Black Method (1934) [11] in which chromic acid is created which in presence of sulfuric acid, oxidizes organic carbon. Back titration was performed using 0.5 N ferrous ammonium sulphate (FAS) and the residual chromic acid. The soil macronutrient (N, P, K and S) was measured according to different methods. Available nitrogen was measured by Alkaline $KMnO_4$ method as proposed by Subbiah and Asija (1956) [10]. This procedure involves distillation of soil with alkaline $KMnO_4$ solution and the amount of liberated NH_3 was absorbed in boric acid, which was determined by titration with standard acid. For extractable phosphorus, the soil was extracted by (0.72 N NaOAc + 0.52 N CH3COOH) as described by Morgan method **(**Morgan, 1941) [7] and followed by color development by ascorbic acid method (Murphy and Riley, 1962) [8] and the available phosphorus concentration in soil samples was measured using spectrophotometer at 820nm and values were expressed in kg $ha^{-1.}$ The Extractable potassium was also measured by extracting the soil by **(**0.72N NaOAc + 0.52N CH_3COOH**)** and determined by flame photometry**.** Available Sulphur was evaluated by the method of Chesnin and Yien (1951) [2]. Which include the extraction of the soil by 0.15% $CaCl_2$ and the extractable S was determine by turbidimetry using $BaCl_2$. The extent of developed turbidity was measured at 420 nm wavelength by spectrophotometer.

3. Results and Discussion

3.1 General properties of soil of Havalbag block of Almora district

General properties, pH, EC, Organic carbon, Organic matter content, texture and soil color of soils collected from Block Havalbag of Almora district are shown in Table 1.

Table 1: General Physiochemical properties of soils collected from Block Havalbag.

Location	pH (Mean)	EC (dSm^{-1}) (Mean)	OC (%) (Mean)	Texture	Color
Pilkha	6.26 – 6.56 (6.45)	0.025 – 0.132 (0.093)	0.80 – 1.59 (1.12)	Sandy Clay	Reddish Gray
Dhanoli	5.76 – 6.37 (6.03)	0.012 – 0.131 (0.085)	1.01 – 1.24 (1.161)	silty clay loam	Dark Brawn
Matela	5.94 – 6.52 (6.20)	0.084 – 0.134 (0.105)	0.20 – 0.41 (0.33)	Sandy clay	Dark Brown
Pakhura	6.43 – 6.78 (6.65)	0.184 – 0.286 (0.227)	0.92 – 1.68 (1.32)	Sandy Loam	Brown
Godi	5.67 – 6.29 (5.91)	0.146 – 0.189 (0.177)	1.01 – 1.15 (1.06)	Sandy Loam	Reddish Gray
Kharkiya	5.68 – 6.85 (6.08)	0.242 - 0.451 (0.313)	0.54 - 1.25 (1.00)	Sandy	Dark Brawn
Range Overall mean	5.67 - 6.85 (6.22)	0.012 - 0.451 (0.167)	0.20 - 1.68 (1.00)		

In Block Havalbag 6 location: Pilkha, Dhanoli, Matela, Pakhura, Godi and Kharkiya were selected. The range of pH was found 5.67 – 6.85, with a mean value of 6.22. The highest and lowest pH was found at Pakhura (pH 6.65) and Godi (pH 5.91), respectively. The range of electrical conductivity was found 0.012 - 0.451 dSm^{-1}, with the mean value of 0.167 dSm^{-1}. The highest and lowest EC was found at Kharkiya (0.313dSm^{-1}) and Dhanoli (0.085 $dSm^{-1)}$, respectively. The range of organic carbon was found 0.20 - 1.68%, with the mean value of (1.00%. The highest and lowest OC was found at Pakhura (1.32%) and Matela (0.33%), respectively.

Table 2: Availability of macronutrients extracted in different location of block Havalbag.

Location	N- $KMnO_4$ Kg ha^{-1}	P- Morgan Kg ha^{-1}	K- Morgan Kg ha^{-1}	S- $CaCl_2$ Kg ha^{-1}
Pilkha	150.53 - 165.51 (157.21)	25.15 – 41.94 (35.08)	161.82 – 174.47 (165.52)	41.83 – 49.57 (45.89)
Dhanoli	99.10- 118.24 (108.72)	26.32 – 29.25 (27.75)	165.34 – 183.76 (152.51)	35.46 - 44.39 (39.54)
Matela	173.11-176.33 (175.04)	41.98 – 65.07 (53.00)	18.923 – 169.67 (158.36)	12.0 – 22.84 (17.83)
Pakhura	117.91-128.68 (122.67)	41.59 – 46.35 (43.71)	168.55 – 143.57 (170.78)	37.49 – 38.59 (43.26)
Godi	131.93-144.2 (139.34)	48.12 – 54.78 (51.70)	145.61 - 166.52 (168.77)	32.49 – 42.67 (38.15)
Kharkiya	101.57-117.31 (108.39)	49.24 – 52.81 (51.18)	155.67 - 176.2 (163.77)	35.39 – 43.26 (38.48)
Range Overall mean	129.03 - 141.72 (135.23)	25.15 - 65.07 (43.73)	143.57 - 178.64 (163.29)	12.00 - 49.57 (37.19)

In Block Havalbag 6 location: Pilkha, Dhanoli, Matela, Pakhura, Godi and Kharkiya were selected. The soil available N was measured by $KMnO_4$ method. The range of available N was found 129.03 - 141.72 kg ha^{-1} with a mean value of 135.23 kg ha^{-1}. The highest N content was found in Matela with mean value of. 175.04 kg ha^{-1} and the lowest N content was found in Kharkiya with a mean value 108.39 kg ha^{-1}. Extractable P was measured by the Morgan method. The range of extractable P was found 25.15 - 65.07 kg ha^{-1} with a mean value of 43.73kg ha^{-1}. The highest P content was found in Matela with mean value of 53.00 kg ha^{-1} and the lowest P content was found in Dhanoli with mean value 27.75kg ha^{-1}. The soil available K was measured by the Morgan method. The range of available K was found 143.57 - 178.64 kg ha^{-1} with a mean value of 163.29 kg ha^{-1}. The Highest K content was found in Pakhura with mean value of 170.78 kg ha^{-1} and the lowest K content was found in Dhanoli with a mean value of 152.51 kg ha^{-1}. Extractable S was measured by the $CaCl_2$ method. The range of extractable S was found 12.00 - 49.57 kg ha^{-1} with a mean value of 37.19 kg $ha^{-1.}$ The highest S content was found in Pilkha with a mean value of 45.89 kg ha^{-1} and the lowest S content was found in Matela with a mean value of 17.83 kg ha^{-1}.

Table 3: Correlation of soil properties and N, P, K, and S of Location Havalbag.

	pH	EC	OC	N- $Kmno_4$	P-Morgan	K- Morgan	S- $CaCl_2$
pH	1						
EC	0.275	1					
OC	-0.045	0.058	1				
N	0.488*	0.124	0.008	1			
P-Morgan	0.308	0.585*	-0.016	0.428*	1		
K-Morgan	0.520*	0.504*	0.070	0.202	0.277	1	
S-$CaCl_2$	0.124	0.126	0.749**	0.051	0.048	0.082	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Linear relationships present among the measured soil parameters and Havalbag has been presented in Table No. 3, soil pH positively and significantly correlated with available N (r = 0.488), available K (r = 0.520), at the 5% non-significance level, positively and non-significantly correlated with available P (r = 0.308), S available (r = 0.124). Electrical conductivity was positively and significantly correlated with available P (r = 0.585), available K(r = 0.504), at the 5% non-significance level, positively and non-significantly correlated with available N (r = 0.124) and S available (r = 0.126). The organic carbon showed positive and significantly correlated with S available (r = 0749) at the 1% non-significance level, positive and non-significant correlation with available N (r = 0.008) and available K (r = -0.070). There is negative and non- significant correlation between OC and available P (r = -0.016).

4. Conclusion

From this study, it may conclude that the soil of Havalbag block of Almora district is Sandy Loam, acidic in nature and rich in organic Carbon. The nutrient indices study conclude that the soil is high in extractable S whereas medium in available K and low in available P and available N. Correlation study suggest that the soil pH is positive and significantly correlated with available N and K, whereas the EC showed positive and significant correlation with available P and available K. The organic carbon showed a positive and significantly correlated with available S.

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