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Comparative Study on the Seasonal Variations in the Soil Edaphic and Chemical Factors of Agricultural and Grass Land Habitats of Central Travancore Kerala

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Abstract: ***Comparison between agriculture land and grass land habitats in Alapuzha district on the basis of soil edaphic factors like temperature, p^H, Organic carbon content (OC), moisture content, Exchangeable Acid (EA), Exchangeable Base (EB), sand , silt , clay and soil chemical factors like nitrogen , phosphorous, potassium , calcium and magnesium contents. 20 agricultural land site and 20 grass land sites were selected. Soil samples of 5×5 cm^2 area from a depth of 5 cm were randomly collected from agriculture and grass land habitats. Monthly samples were collected and pooled into four seasons like pre monsoon, monsoon post monsoon and summer. Mean with standard deviation were taken. Seasonal and site wise variation were analyzed by using two way Anova. The study shows that the agriculture land soil has high nitrogen content (2844.83 ppm), Phosphorous content (10.24 ppm), and potassium content (144.2 ppm). The grass land soil has high organic carbon content (4.56 %); calcium content (1564.43ppm) and magnesium content (292.84 ppm).***

Keywords: soil edaphic factors, organic carbon content, soil chemical factors, soil fertility, habitat

1. Introduction

Soil is the vital part of the natural environment that covers much of the earth's land surface. Soil is important because it provides a place for plants to grow and contains a lot of living and non living materials like rocks, minerals, bacteria, animals and nutrients. The significance of nutrient cycling depends on the quantity of plant detritus available for decomposition and the rate at which decomposers**.** Soil composition changes due to environmental factors, along with the influence of man and land use.

The soil ecosystem is an interdependent life-support system composed of air, water, minerals, organic matter, and macro- and micro-organisms. Mineral portion of the soil which consists of three distinct particle sizes sand, silt, clay. Sand cannot hold nutrients, so sandy soils are not productive in nature. Moisture and temperature also influences the fertility of the soil. In most soil the majority of carbon is held as soil organic carbon. The amount of organic carbon in the soil depends on various factors like soil texture, climate, vegetation and land use. Soil organic matter is the major source of energy for soil microorganisms. The soil containing primary nutrients like Nitrogen, Phosphorus, Potassium and the secondary nutrients like Calcium and Magnesium also influences the fertility of the soil.

The present study was under taken for the comparative study between agricultural land habitat and grass land habitat on the basis of soil edaphic factors like soil temperature, pH, exchangeable acid, exchangeable base, organic carbon content, moisture content, sand silt, and clay content and soil chemical factors like nitrogen, phosphorus, potassium, calcium and magnesium content.

2. Methodology

2.1 Study area

The study areas were selected in Central Travancore area of Alappuzha district, lies between 9º5' and 9º54' North latitude and between 76º17' and 76º40' East longitudes.

2.2 Collection and transportation of sample

20 agricultural land sites and 20 grass land sites were selected. From these sites soil samples of 5×5 cm^2 area from a depth of 5 cm were randomly collected using soil auger. Collected soil was taken to laboratory in polythene covers. Monthly samples were collected from the study sites during pre monsoon (March, April, and May), monsoon (June, July, and August), post monsoon (September, October, and November) and summer (December, January, February) seasons 2014.

2.3 Soil edaphic factors analysis

From the soil samples the soil edaphic factors like soil temperature, pH, exchangeable acid, exchangeable base, organic carbon content, moisture content, sand silt, and clay content were detected. The soil chemical factors like nitrogen, phosphorus, potassium, calcium and magnesium content were analyzed. The soil temperature was measured from the site itself using soil thermometer. Soil pH was measured using soil pH meter. Exchangeable acid and exchangeable base were measured using the procedure of Trivedy and Goel (1987). Soil organic carbon content was measured by using the procedure of Walkley and Black (1934). Soil moisture content was measured by gravimetry method.

2.4 Soil chemical factors analysis

Soil samples are air dried and sieved, from this soil samples the chemical factors like nitrogen, phosphorus, potassium, calcium, and magnesium were analyzed. The nitrogen content was analyzed by Kjeldahl distillation method, the phosphorous content was analyzed by Molybdate stannous chloride method, potassium content was analyzed by flame photometry method (APHA, 2012). The calcium and magnesium content of the soil were analyzed by the methods of Jackson (1958).

2.5 Statistical analysis

Descriptive statistics were done by using Microsoft excel software. Two way Analysis of variance (ANOVA) was conducted to determine any significant difference in the value of each parameter between sites and seasons using SPSS package 14.00.

3. Result

3.1 Agricultural habitat

3.1.1 Soil edaphic factors

In agricultural habitat the soil edaphic factors like soil temperature, pH, exchangeable acid, exchangeable base, organic carbon content, moisture content, sand, silt, and clay content were detected.

Soil temperature in agricultural land was at an average of 27.3 ^{0}C in pre monsoon, 24.2 ^{0}C in monsoon, 26.2^{0}C in post monsoon, 28.5^{0}C in summer (Table 1). The two way Anova showed no significant variation between sites (P>0.05) and significance variation between seasons (P<0.05) (Table 2). The soil pH in agricultural land was an average of 5.8 in pre monsoon, 5.8 in monsoon, 5.8 in post monsoon, 5.8 in summer (Table 1).The agricultural habitat was acidic in nature. The two way Anova showed the pH of the soil have no significant variation between sites (P>0.05) and showed significance variation between seasons (P<0.05) (Table 2). The moisture content in agricultural habitat was an average of 77% in pre monsoon, 89% in monsoon, 82% in post monsoon, and 76% in summer (Table 1). The two way Anova showed the moisture content have no significant variation between sites (P>0.05) and showed significance variation between seasons (P<0.05) (Table 2).

The organic carbon content in agricultural habitat was an average of 2.73% in pre monsoon, 2.82% in monsoon, 2.79% in post monsoon, and 2.83% in summer (Table 1). The two way Anova showed the organic carbon content have no significant variation between sites (P>0.05) and showed significance variation between seasons (P<0.05) (Table2).The exchangeable acid in agricultural habitat was an average of 81% in pre monsoon, 82% in monsoon, 81% in post monsoon, 83% in summer (Table 1). The two way Anova showed the exchangeable acid content in agricultural soil have no significant variation between sites (P>0.05) and showed significance variation between seasons (P<0.05) (Table2). The exchangeable base in agricultural habitat was an average of 20% in pre monsoon, 16% in monsoon, 19% in post monsoon, 18% in summer (Table 1). The two way Anova showed the exchangeable base content in agricultural soil have no significant variation between sites (P>0.05) and showed significance variation between seasons (P<0.05) (Table 2).

The sand content in agricultural habitat was an average of 9% in all seasons. The silt content was an average between 0.13% and 0.18%. The clay content was an average between 14 % and 18% was showed good porosity (Table 1). The two way Anova showed the sand content have no significant variation between sites and seasons (P>0.05) (Table2). The two way Anova showed the silt and clay content have no significant variation between sites (P>0.05) and showed significance variation between seasons (P<0.05) (Table 2).

Table 1: Soil edaphic factors of agricultural land at different seasons (Mean ± SD)

Season	Temperature (ºC)	pH	Moisture (%)	OC%	EA%	EB%	Sand%	Silt%	Clay%
Pre monsoon	27.32 ± 1.46	5.86 ± 0.006	76.67 ± 2.05	2.73 ± 0.048	81.43 ± 1.073	20.76 ± 1.710	9.53± 1.395	0.18 ± 1.005	16.1± 0.788
Monsoon	24.28 ± 0.34	5.88 ± 0.008	88.83 ± 0.87	2.82 ± 0.137	82.03± 0.804	16.9 ± 0.846	9.83 ± 1.434	0.13 ± 0.020	16.83 ± 0.792
Post monsoon	26.29 ±0.43	5.84± 0.011	82.03 ± 1.37	2.79 ± 0.114	81.06 ± 0.761	19.97± 1.538	9.73± 1.397	0.13± 0.010	14.57 ± 0.577
Summer	28.51 ± 0.50	5.86 ± 0.010	75.8 ± 1.12	2.83 ± 0.038	83.06 ± 0.892	18.2 ± 1.729	9.83 ± 1.487	0.15 ± 0.020	18.07± 0.788

Table 2: Two way Anova showing Soil edaphic factors in Agricultural habitat

Parameter analyzed	*Comparison aspects*	*F value*	*F critical value 5% level*	*P value*
Temperature	Between habitats	0.696113	2.456281	0.704406
	Between season	2.96E-21	3.554557	$2.96X10^{-21}$
p^H	Between habitats	0.660172	2.250131	0.736526
	Between season	69.73203	2.960351	$7.75X10^{-13}$
Moisture content %	Between habitats	2.178872	2.250131	0.057002
	Between season	1051.498	2.960351	$4.63X10^{-28}$
OC %	Between habitats	0.660172	2.250131	0.736526
	Between season	69.73203	2.960351	$7.75X10^{-13}$
EA %	Between habitats	2.957597	2.50131	0.013974
	Between season	65.57597	2.96035	$1.61X10^{-12}$
EB %	Between habitats	0.939328	2.250131	0.5.8395
	Between season	63.87757	2.960351	$2.19X10^{-12}$
	Between habitats	0.61483	2.250131	0.558056

Sand %	Between season	0.500515	2.960351	$2.78X10^{-14}$
Silt %	Between habitats	0.875579	2.250131	0.558056
	Between season	91.8405	2.960351	$2.78X10^{-14}$
Clay %	Between habitats	0.73355	2.250131	0.675088
	Between season	168.8798	2.960351	$1.33X10^{-17}$

In agricultural habitat, the soil chemical factors like factors like nitrogen, phosphorus, potassium, calcium, and magnesium were analyzed. The nitrogen content in agricultural habitat was an average of 2864.1 ppm in pre monsoon, 2871.83 ppm in monsoon, 2844.17 ppm in post monsoon, 2859.77 ppm in summer.).

3.1.2 Soil chemical factors

Table 3: Soil chemical factors of agriculture land at different seasons (Mean ± SD)

Season	Nitrogen (ppm)	Phosphorus (ppm)	Pottasium (ppm)	Calcium (ppm)	Magnesium (ppm)
Pre monsoon	2864.1 ±15.69	10.24 ±0.106	144.2 ±2.353	695.06 ±1.433	163.98 ±2.028
Monsoon	2871.8 ±3.78	9.39 ±0.160	123.4 ±5.649	684.93 ±2.255	137.62 ±1.455
Post monsoon	2844.17 ±2.74	9.71 ±0.095	137.06 ±0.983	689.13 ±3.527	141.72 ±2.865
Summer	2859.77 ±8.47	9.27 ±0.102	136.7 ±1.665	681.83 ±0.799	155.03 ±1.989

Table 4: Two way Anova showing soil chemical factors in agricultural habitat

Parameter analyzed	Comparison aspects	F value	F critical value 5% level	P value
Nitrogen (ppm)	Between habitats	1.716887	2.250131	0.133595
	Between season	227.7467	2.960351	$2.82X10^{-19}$
Phosphorus (ppm)	Between habitats	1.270701	2.250131	0.296983
	Between season	720.0287	2.960351	$7.28X10^{-26}$
Potassium (ppm)	Between habitats	1.110718	2.250131	0.388568
	Between season	386.613	2.960351	$2.78X10^{-22}$
Calcium(ppm)	Between habitats	0.437592	2.250131	0.902439
	Between season	172.9186	2.960351	$9.84X10^{-18}$
Magnesium (ppm)	Between habitats	0.606525	2.250131	0.780463
	Between season	663.4462	2.960351	$2.17X10^{-25}$

The phosphorus content was an average of 10.24 ppm in pre monsoon, 9.39 ppm in monsoon, 9.71 ppm in post monsoon, 9.27 ppm in summer. The potassium content was an average of 144.2 ppm in pre monsoon, 123.4 ppm in monsoon, 137.06 ppm in post monsoon, 136.7 ppm in summer (Table3). The two way Anova showed the nitrogen, phosphorus and potassium content have no significant variation between sites (P>0.05) and showed significance variation between seasons (P<0.05) (Table 4). The calcium content in agricultural habitat was an average of 695.07 ppm in pre monsoon, 684.93 ppm in monsoon, 689.13 ppm in post monsoon, 681.83 ppm in summer. The magnesium content in agricultural habitat was an average of 163.98 ppm in pre monsoon, 137.62 ppm in monsoon, 141.72 ppm in post monsoon, 155.03 ppm in summer (Table3). The two way Anova showed the calcium and magnesium content have no significant variation between sites (P>0.05) and showed significance variation between seasons (P<0.05) (Table 4)

3.2 Grassland habitat

3.2.1 Soil edaphic factors

In grass land habitat the soil edaphic factors like soil temperature, pH, exchangeable acid, exchangeable base, organic carbon content, moisture content, sand, silt, and clay content were detected.

Soil temperature in grass land was at an average of 27.3^0C in pre monsoon,23.5^0 C in monsoon, 26.9^0C in post monsoon,27.9^0C in summer (Table 5).The two way Anova showed no significant variation between sites (P>0.05) and significance variation between seasons (P<0.05) (Table 6). The soil pH in grass land was an average of 6.5 in pre monsoon, 6.36 in monsoon, 6.4 in post monsoon, and 6.4 in summer (Table 5). The agricultural habitat was acidic in nature. The two way Anova showed the pH have no significant variation between sites (P>0.05) and showed significance variation between seasons (P<0.05) (Table 6). The moisture content in grass habitat was an average of 76% in pre monsoon, 84% in monsoon, 78% in post monsoon, and 71% in summer (Table 5). The two way Anova showed the moisture content have no significant variation between sites (P>0.05) and showed significance variation between seasons (P<0.05) (Table 6). The organic carbon content in grassland habitat was an average of 4.50 in pre monsoon, 4.55 in monsoon, 4.54 in post monsoon, and 4.41 in summer (Table 5). The two way Anova showed the organic carbon content have no significant variation between sites (P>0.05) and showed significance variation between seasons (P<0.05) (Table 6).

The exchangeable acid in grass land habitat was an average of 83% in pre monsoon, 71% in monsoon, 75% in post monsoon, and 77% in summer (Table 5). The exchangeable base in grass land was an average of 19% in pre monsoon, 18% in monsoon, 14% in post monsoon, 13% in summer (Table 5). The two way Anova showed the exchangeable acid and exchangeable base content in grass land soil have no significant variation between sites (P>0.05) and showed significance variation between seasons (P<0.05) (Table 6). The sand content in agricultural habitat was an average of 7% in all seasons. The silt content was an average between 0.54% and 0.85%. The clay content was an average between 25% and 27%. The two way Anova showed the silt and clay content have no significant variation between sites (P>0.05) and showed significance variation between seasons (P<0.05) (Table 6).

Table 5: Soil edaphic factors of grass land at different seasons (Mean ± SD)

Season		pH	Moisture (%)	OC%	EA%	EB%	Sand%	Silt%	Clay%
Pre monsoon	27.34 ±1.597	6.59 ±0.065	75.56 ±0.989	4.50 ±0.798	83.03 ±0.746	19.73 ±1.075	7.43 ±0.577	0.85 ±0.026	26.47 ±0.519
Monsoon	23.53 ±0.544	6.36 ±0.023	83.8 ±1.698	4.55 ±0.179	71.53 ±0.989	18.37 ±1.430	7.47 ±0.577	0.85 ±0.024	27.13 ±0.846
Post monsoon	26.90 ±0.443	6.44 ±0.026	78.4 ±1.115	4.54 ±0.168	75.46 ±0.577	14.27 ±0.883	7.5 ±0.577	0.54 ±0.028	24.57 ±0.577
Summer	27.99 ±0.325	6.46 ±0.011	71.03 ±0.789	4.41 ±0.080	77.3 ±1.859	13.9 ±0.851	7.5 ±0.577	0.64 ±0.020	26.83 ±0.983

Table 6: Two way Anova showing Soil edaphic factors in grass land habitat

Parameter analyzed	*Comparison aspects*	*F value*	*F critical value 5% level*	*P value*
Temperature	Between habitats	0.528398	2.250131	0.840946
	Between season	1854.549	2.960351	$2.45X10^{-31}$
p^H	Between habitats	1.928882	2.250131	0.090411
	Between season	1565.053	2.960351	$2.24X10^{-30}$
Moisture content %	Between habitats	1.165202	2.250131	0.355149
	Between season	1219.919	2.960351	$6.33X10^{-29}$
OC %	Between habitats	2.376614	2.250131	0.039657
	Between season	347.21	2.960351	$1.14X10^{-21}$
EA %	Between habitats	0.629371	2.250131	0.761921
	Between season	1943.308	2.960351	$1.23X10^{-31}$
EB %	Between habitats	0.37457	2.250131	0.937261
	Between season	238.1649	2.960351	$1.58X10^{-19}$
Sand %	Between habitats	2.205479	2.250131	0.054278
	Between season	0.452055	2.960351	0.717948
Silt %	Between habitats	1.661122	2.250131	0.147956
	Between season	4078.268	2.960351	$5.71X10^{-36}$
Clay %	Between habitats	2.272727	2.250131	0.047968
	Between season	327.3636	2.960351	$2.48X10^{-21}$

3.2.2 Soil chemical factors

In grass land habitat soil chemical factors like nitrogen, phosphorus, potassium, calcium and magnesium were analyzed. The nitrogen content in grass land habitat was an average of 1032.4ppm in pre monsoon, 1022.3ppm in monsoon, 1020.73ppm in post monsoon, 1031.2ppm in summer. The phosphorus content was an average of 4.61ppm in pre monsoon, 4.87ppm in monsoon, 4.48ppm in post monsoon, 4.73ppm in summer. The potassium content was an average of 116.7ppm in pre monsoon, 111.1ppm in monsoon, 118.53ppm in post monsoon, 113.53ppm in summer (Table 7). The two way Anova showed the NPK content have no significant variation between sites (P>0.05) and showed significance variation between seasons (P<0.05) (Table 8).

The calcium content in grass land habitat was an average of 1549.34ppm in pre monsoon, 1538.83ppm in monsoon, 1564.43 ppm in post monsoon, 1542.17ppm in summer. The magnesium content in grass land habitat was an average of 288.85ppm in pre monsoon, 286.97 ppm in monsoon, 284.11 ppm in post monsoon, 292.84ppm in summer (Table 7). The two way Anova showed the calcium content have no significant variation between sites and seasons (P>0.05) (Table 8), but in magnesium content have no significant variation between sites (P>0.05) and showed significance variation between seasons (P<0.05) (Table 8).

Table 7: Soil chemical factors of grassland at different seasons (Mean±SD)

Season	Nitrogen (ppm)	Phosphorus (ppm)	Potassium (ppm)	Calcium (ppm)	Magnesium (ppm)
Pre monsoon	1032.4 ±4.53	4.61 ±0.06	116.7 ±2.23	1549.34±1.22	288.85 ±0.30
Monsoon	1022.3 ±1.33	4.87±0.036	111.1 ±0.93	1538.83±4.75	286.97 ±0.55
Post monsoon	1020.73 ±3.75	4.48±0.177	118.53 ±1.26	1564.43±2.14	284.11 ±0.73
Summer	1031.2 ±1.91	4.73±0.053	113.53 ±1.46	1542.17±1.13	292.84 ±0.37

Table 8: Two way Anova showing soil chemical factors in grass land habitat

Parameter analyzed	*Comparison aspects*	*F value*	*F critical value 5% level*	*P value*
Nitrogen (ppm)	Between habitats	1.172682	2.250131	0.350742
	Between season	249.3954	2.960351	$8.68X10^{-20}$
Phosphorus (ppm)	Between habitats	2.264944	2.250131	0.048658
	Between season	300.8558	2.960351	$7.5X10^{-21}$
Potassium (ppm)	Between habitats	0.510481	2.250131	0.853963
	Between season	163.4538	2.960351	$2.02X10^{-17}$
Calcium (ppm)	Between habitats	0.985126	2.250131	0.474294
	Between season	0.263961	2.960351	0.850736
Magnesium (ppm)	Between habitats	1.188144	2.250131	0.341771
	Between season	533.66	2.960351	$3.91X10^{-24}$

4. Discussion

From agricultural habitat and grass land habitat soil edaphic factors were analyzed. Soil edaphic factors like soil temperature, pH, exchangeable acid, exchangeable base, organic carbon content, moisture content, sand silt, and clay content were detected. The temperature influences the fertility of the soil, if the temperature increases the decomposition of organic matter increases. The grass land habitat showed an optimum range of temperature. Environmental factors, can affect soil pH, the p^H ranges showed that the two habitats were acidic in nature. The plants and soil life forms prefer either alkaline or the acidic nature of the soil. pH can also affect the availability of nutrients in the soil. The organic carbon content was more in grass land than agricultural land. The agricultural land was sandy in nature, leaching is active in sandy soils. The clay content was more in grass land habitat.The clay content and organic matter, which influence the exchange capacity of the soil.

The soil chemical factors like nitrogen, phosphorus, potassium, calcium and magnesium contents were analyzed. Nutrient balance is very important in soil habitat. The mobility of nutrients within the soil is closely related to the chemical properties of the soil. The present study showed the agricultural habitat soil had high amount of nitrogen, phosphorus, potassium. The very high level of nitrogen and phosphorus content in the agriculture land is due to the application of chemical fertilizers during agricultural activity (Thomas, 1994). Phosphorus, nitrogen and potassium, contents are very essential for the normal growth of plants. The magnesium and calcium content were more in the grass land habitat. The high availability of magnesium and calcium contributes the low survival of higher plants in grass land (Sankar, 1996). Low soil magnesium levels will affect grass yield as well as mineral balance in the animal.

4 Summary and Conclusion

Compared the agricultural habitat and grass land habitat based on the soil edaphic factors like soil temperature, pH, exchangeable acid, exchangeable base, organic carbon content, moisture content, sand silt, and clay content, soil chemical factors like nitrogen, phosphorus, potassium, calcium and magnesium content. In each habitat 10 sites were selected for the soil study. Soil samples were taken from each study site monthly during pre monsoon, monsoon, and post monsoon and summer seasons. Mean with standard deviation were taken for each parameter value. Two way ANOVA was conducted to test whether the samples have variation in values between sites and seasons. From this study found that the grass land habitat was more fertile than the agricultural habitat.

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Author profile

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Vinod P., assistant professor in Zoology, engaged in research work leading to Ph.D. on soil biology and soil faunal distribution. Areas of interest are paedology and entomology.