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Relationship Between Levels of Organic Carbon, Total Nitrogen Available Nitrogen, Phosphorus and Potassium in Cold Desert Soils of Kinnaur(H.P.)

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ABSTRACT

In the soils formed under almost similar altitude (1974-4137 m) the simple correlation coefficients between organic carbon, total N, available N, P and K were modified by the total precipitation which were significant in Sangla tehsil soils receiving about 500 mm of annual precipitation whereas the correlation coefficients of organic carbon, total N, available N and P with available K were not significant in Hangrang sub-tehsil soils receiving about 75 mm of total precipitation. In relatively high altitude (3020-4137 m) soils, the correlation of organic carbon with available N, P and K showed a steady increase with the increase in precipitation. In the relatively low altitude (1974-2196 m) soils, the correlations worked out in soils formed under relatively high precipitation (400-700 mm) among the organic carbon and available K with available N, P and K showed a similar trend to that observed in the soils formed under relatively high altitude and low precipitation (upto 100 mm). Further the correlation between the various soil parameters were found to be highly significant in soils formed under relatively low altitude and low precipitation.

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INTRODUCTION

The soils of Kinnaur come under cold desert soils as the annual precipitation and mean annual temperature is about 500 mm and 15° C, respectively. The annual precipitation of the area ranges from 75 mm to 700 mm. The maximum and minimum temperatures are about 25° C and a few degrees below zero point, respectively. The altitude of the district ranges in between 1974 m and 4137 m above MSL.

The relationship between organic carbon and nitrogen in soils is well established and that of organic carbon and soil phosphorus is beyond doubt especially in soils which contain high organic matter. But the relationship between organic carbon, total nitrogen, available N, P and K is very rare. As the above mentioned soil constituents were very high in Kinnaur soils (Negi, 1976) it was thought worth while to study the relationship among the soil constituents under different sets of annual precipitation and altitudes prevailing in the area. Once the significant relationships among the different soil constituents were established, it was worth computing

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simple linear regression equations taking soil constituents which are difficultly estimated as dependent variables. From these regression equations, one can easily calculate the values of different soil constituents only by estimating one easily determined soil constituent. So, with the above mentioned objectives the present investigation was undertaken.

MATERIALS AND METHODS

One tehsil, one sub-tehsil and six villages were selected for the present investigation taking into consideration the altitude and precipitation (Table 1). Number of soil samples collected are also indicated in Table 1. The physico-chemical characteristics of soils are given elsewhere (Negi, 1976).

TABLE 1

Elevation and annual precipitation of the places from where soil samples were collected.

Sr. No.	*Name of place*	*No. of samples*	*Altitude above MSL(m)*	*Precipitation (mm)*
1	Sangla tehsil	21	1974-4137	510-570
2	Hangrang sub-tehsil	17	2196-3627	75
3	Thangi	20	3020	108
4	Leo	29	2196	75
5	Kalpa Kanda	20	3660	372
6	Jani	20	2066	172
7	Chitkul	20	4137	520
8	Kilba	24	1974	570

TABLE 2

Simple correlation coefficient between different soil constituents.

	Sangla tehsil				*Hangrang sub-tehsil*			
	Total	*Available (kg/ha)*			*Total*	*Available (kg/ha)*		
	N %	*N*	*P*	*K*	*N* %	*N*	*P*	*K*
Organic carbon (%)	0.596**	0.620**	0.516*	0.576**	0.928**	0.721**	0.634**	0.350
Total N (%)	—	0.973**	0.675**	0.726**	—	0.799**	0.624**	0.384
Available N (kg/ha)	—	—	0.657**	0.743**	—	—	0.679**	0.476*
Available P (kg/ha)	—	—	—	0.779**	—	—	—	0.184

*Significant at 5% level.
**Significant at 1% level.

TABLE 3

Simple linear regression equations computed by taking organic carbon (Org. C) and available K(K_A) as independent variables and total N (N_T) and available N(N_A) and P(P_A) as dependent variables.

Place	*Regression equation*	R^2 *-value*
Sangla tehsil	$N_T = 0.042 + 0.084$ Org. C	35.52**
	$N_A = 97.51 + 176.36$ Org. C	38.44**
	$P_A = 2.92 + 32.06$ Org. C	26.63*
	$K_A = 5.85 + 240.35$ Org. C	33.18**
	$N_T = -0.069 + 0.00057\ K_A$	52.71**
	$N_A = 205.75 + 0.506\ K_A$	55.21**
	$P_A = 10.72 + 0.116\ K_A$	60.05**
Hangrang sub-tehsil	$N_T = -0.027 + 0.118$ Org. C	86.12**
	$N_A = 216.82 + 125.12$ Org. C	51.84**
	$P_A = -30.60 + 79.65$ Org. C	39.69**
Thangi	$N_A = 194.65 + 136.57$ Org. C	19.00*
	$P_A = 13.18 + 0.25\ K_A$	68.70**
Leo	$N_A = -35.84 + 211.25$ Org. C	73.70**
	$P_A = -138.6 + 138.77$ Org. C	34.00**
	$K_A = -30.60 + 172.28$ Org. C	29.50**
	$N_A = 197.41 + 0.41\ K_A$	27.40**
	$P_A = 319.83 + 0.38\ K_A$	25.30**
Kalpa Kanda	$N_A = -6.88 + 166.49$ Org. C	51.20**
	$P_A = -65.20 + 48.02$ Org. C	20.6*
	$K_A = 57.66 + 235.39$ Org. C	22.4*
	$N_A = 217.46 + 0.28\ K_A$	35.40**

	**	*	*			
Organic carbon (%)	0.715	0.453	0.474	0.111	0.113	0.308
	**	*		**	**	
Available K (kg/ha)	0.595	0.541	—	0.723	0.639	—
		Relatively high precipitation (**400-700** *mm*)				
		Chitkul			*Kilba*	
	**	**	**	*		
Organic carbon (%)	0.927	0.808	0.750	0.441	-0.012	0.138
	**	**		*	**	
Available K (kg/ha)	0.798	0.837	—	0.321	0.681	—

*Significant at 5% level.
**Significant at 1% level.

TABLE 6

t-values for testing similarity between estimated and calculated values of soil constituents determined by computing values of organic carbon and available K in respective regression equations.

	Available N (kg/ha)	*Available P (kg/ha)*	*Available K (kg/ha)*
	Relatively low precipitation and low altitude (Leo soils)		
	**		**
Organic carbon (3)	8.67	—	3.36
	*		
Available K (kg/ha)	2.11	1.17	—
	Relatively medium precipitation & high altitude (Kalpa Kanda soil)		
	**	*	*
Organic carbon (%)	4.39	2.18	2.30
	**	*	
Available K (kg/ha)	3.16	2.84	—
	Relatively high precipitation and high altitude (Chitkul soils)		
	**	**	**
Organic carbon (%)	18.38	5.76	4.79
	**	**	
Available K (kg/ha)	5.60	6.77	—

*Significant at 5% level.
**Significant at 1% level.

in Sangla soils where as it was non-significant in case of total N, available N and P values calculated by computing available K values in Hangrang soils. The non-significant t-values in latter group of soils may be due to non-significant correlation coefficients. The regression lines and respective values had been plotted as shown in Fig. 1.

The relationship between organic carobn, available N, P and K had been modified to some extend by the altitude and precipitation both as shown by the simple correlation coefficients (Table 5). Under relatively high altitude soils, all the correlation coefficients were significant except that of organic carbon with available P and K and available

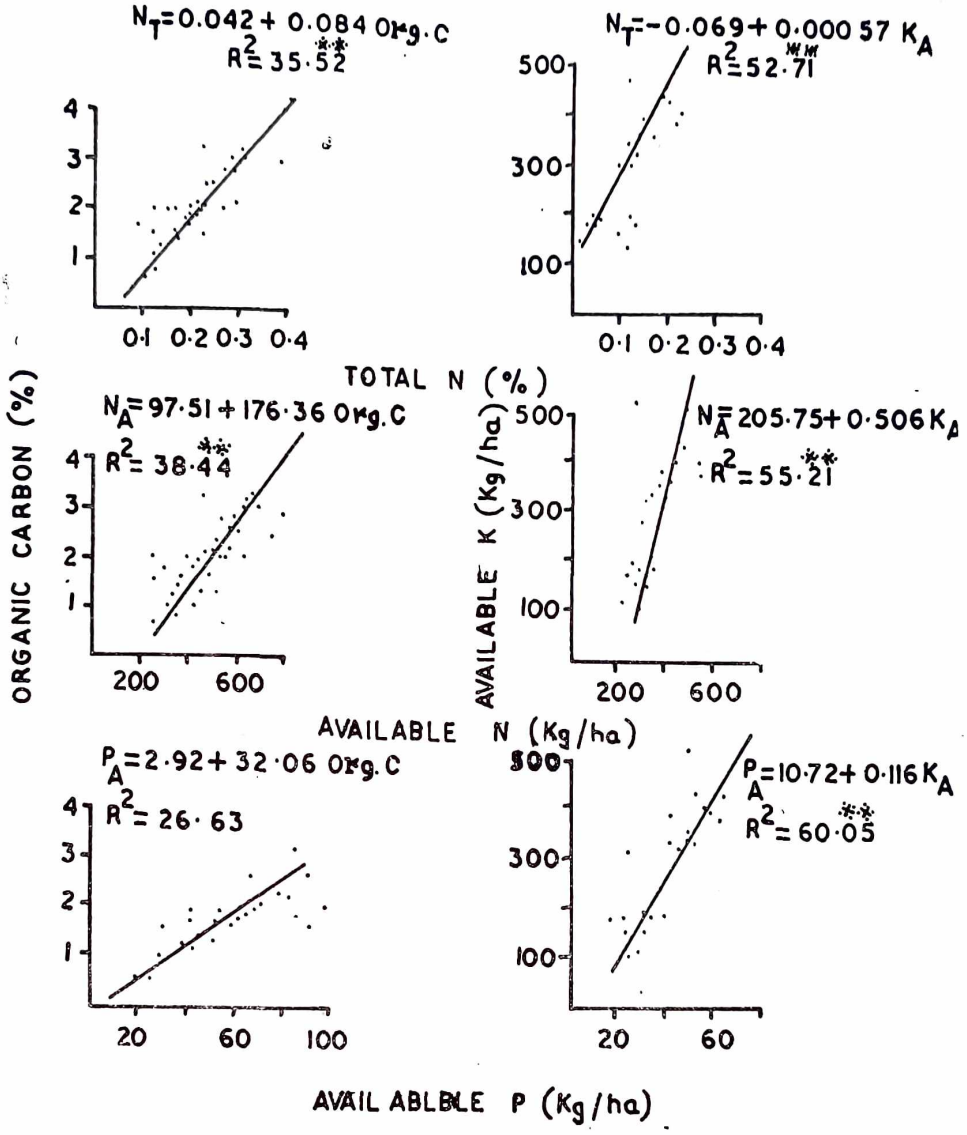

Fig. 1 : Relationship of total N (N_T) available-N (N_A) and available-P (P_A) with Organic Carbon (Org. C) and available-K (K_A) and in Sangla Tehsil soils of Kinnaur.

K with available N under relatively low precipitation. This may be due to the fact that at higher altitude because of low rainfall the vegetation is very sparse which resulted in low organic matter of the soils and under these conditions organic matter is not playing key role towards available N, P and K. Another reason might be the very low decomposition of the small amount of organic matter at higher altitude. The non-significant correlation between available N and available K might be due to the fact that organic carbon has no correlation with available K under these conditions.

Under relatively low altitude soils, the correlation coefficients of organic carbon with available N, P and K in relatively medium precipitation and that of organic carbon with available P and K in relatively high precipitation was

not significant. The former relationship might be due to the fact that in hill soils because of low temperature which results in low organic carbon decompo-

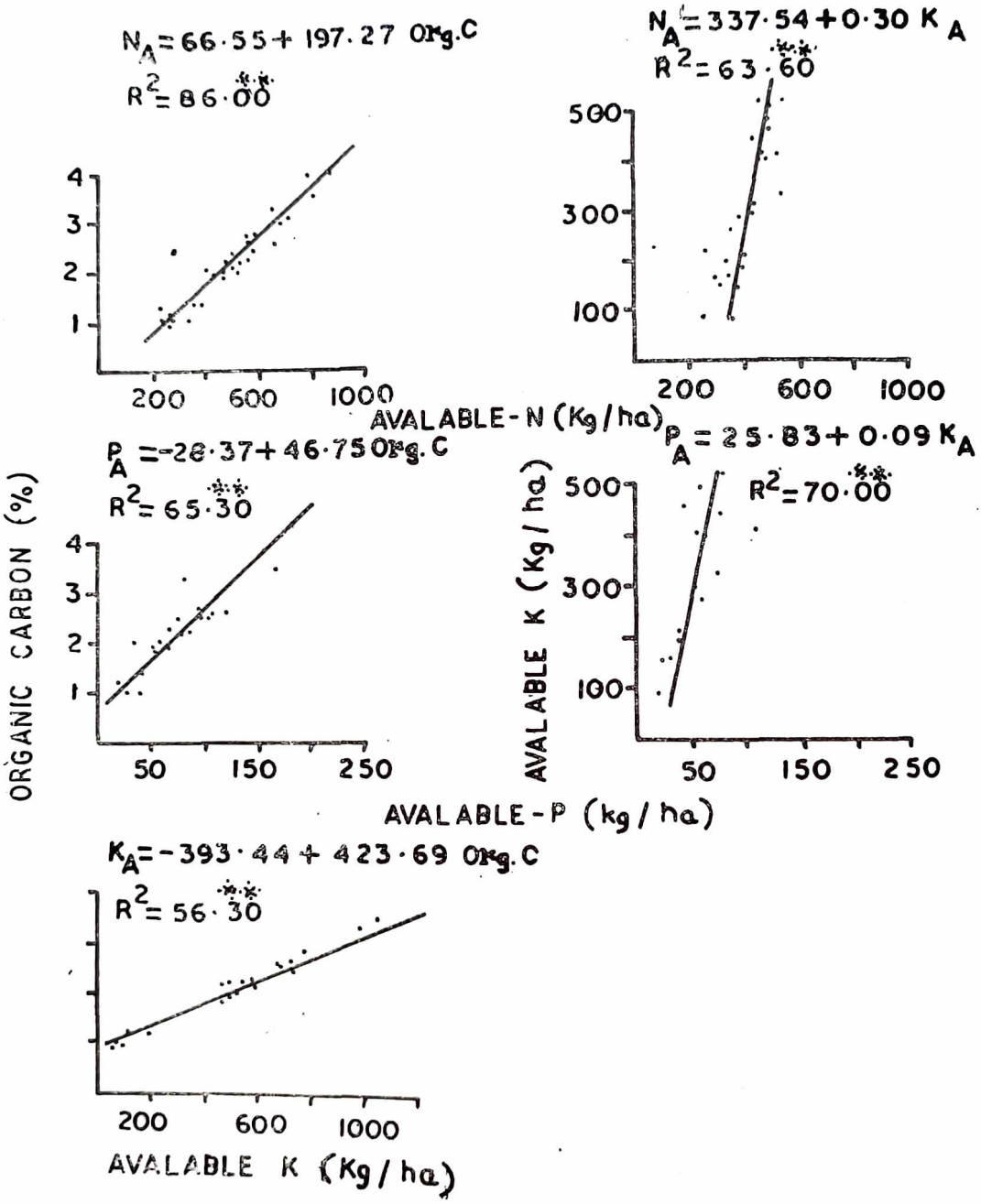

Fig. 2 : Relationship among Organic Carbon (Org. C.) available - N(N_A), available P(P_A) and available - K(K_A) in Chitkul village soils of Kinnaur (H.P.).

sition, organic carbon content of the soils does not give true idea of available nitrogen in the soils. Negi (1976) also reported that in spite of very high organic carbon content of the soils, the district Kinnaur soils contained medium available nitrogen. The latter relationship can be attributeted to the fact that

under relatively high precipitation condition, the availability of phosphorus and potassium is governed more by the moisture status of the soils than its organic carbon content.

The regression lines of the respective regression equations of Chitkul village soils have been presented in Fig. 2. The calculated values of available N, P and K were obtained by computing the value of organic carbon and available K in respective regression equations in case of Leo, Kalpa Kanda and Chitkul villages. The calculated and estimated values were tested with t-test for the difference between the two figures. The t-test was significant in all the cases (Table 6) except available P calculated by computing available K in the respective regression equation in case of Leo village soils. The significance of t-test indicates that the difference between the two values is not significant.

It can be concluded that in Kinnaur soils which can be designated as cold desert soils, organic carbon, total nitrogen, available N, P and K have definite relationship and this relationship is considerably modified by altitude and precipitation of the particular place. In case of meager soil testing facilities, the more difficultly estimated soil constituents e.g. total N, available N, P and K can be calculated by computing values of organic carbon which is estimated easily by simple linear regression equations.

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