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Annual Budget of Nutrients Return Through Litter Fall in Moist Temperate Himalaya (Thalkedar) Forest.

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ABSTRACT

The present investigation carried out at Thalkedar forest in Pithoragarh (Kumaon Himalaya). The input of nutrients (ash, calcium and nitrogen) and energy through litter fall was measured during 1979. The Total annual input of ash, calcium, nitrogen and energy was 332, 66, 155.81, 147.10 Kg/hac/yr and 3014.0 Kcal $\times 10^4$ ha/yr respectively. *Quercus incana* contributed about one fourth to the total input.

INTRODUCTION

Litter fall, one of the most important processes in the forest ecosystem, is a major pathway for both nutrient and energy transfers (Brey and Gorham [1]). It has been argued that a portion of the nutrients extracted from the soil remains locked up in relatively more permanent parts of the trees; the major portion is brought back to the soil surface, where a highly efficient decomposer system helps in the release of the nutrients in simple inorganic forms (Singh[2]). The average nutrient concentration in the litter varies seasonally for several reasons. Different workers (Morrison[3], Cragg, *et al*[4], Killingbuck and wali[5]) reported the concentration in the litter and nutrient release through litter fall in various forests of the world.

Energy is the driving factor for essentially all processes occurring in an ecosystem. Leith[6] pointed out that the calorific values are important for the estimation of the energy flow and food chain within biocoenosis and the best evaluation of the amount and the possible quality of matter transferred can be obtained by using energy values rather than dry matter determination.

Although the temporal variation in the calorific value of tree leaves is well recognised (James and Smith[7]) studies concerning the energy content of litter deposited at different times in the year are lacking. This paper is concerned with the studies on the nutrient concentration of leaf litter and annual nutrient including energy inputs through litter fall in the oak forest.

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MATERIAL AND METHODS

The fresh litter samples from a fixed litter trap which were planted in Thalkedar forest (29° 30' N Lat. and 80° 15' E Long.) with an altitude of 2000 m above mean sea level in Pithoragarh region of Kumaon Himalaya were brought to the laboratory, at the one month interval (1978 to 1979). In laboratory, leaf litter was sorted species wise, ovendried at 80° C, and grind to powder and stored in polythene bags. Ash was determined by igniting the preweighted samples at 550° in a muffle furnace, Calcium and Magnissium were estimated gravimetrically and the nitrogen content was measured by microkjeldahl method (Piper[9]). The calorific values were calculated by Bomb calorimeter (Misra). The Total input of nutrients and calorific values to each species obtained by multiplying the per gram value with the corrosponding biomass on oven dried litter.

RESULTS AND DISCUSSION

It is evident from Table 1 that input of ash content, calcium and nitrogen was maximum in summer followed by winter and rainy seasons. The values markedly influenced by the amount of litterfall in corrosponding seasons. The nutrients input through the leaf was maximum due to *Quercus incana*. The important species which exhibited high calorific values were in order : *Quercus lanuginosa; Q. incana, Q. dilatata; Q. glauca and Ilex* spp. All the above species are evergreen.

The annual input of ash, calcium, nitrogen and energy was estimated at 332.66, 155.81, 147.10 kg/hac and 3014. O K cal x 10^4/ hac/yr, respectively.

TABLE—1

Seasonal nutrient input ($kgha^{-1}$) and average energy content of different litter species and annual energy input through litter fall in moist temperate Himalaya (Thalkedar) forest.

Species	Summer			Rainy			Winter			Average content (cal g dry wt^{-1})	Annual energy (K cal x $10^4 ha^{-1}$
	Ash	Calcium	Nitrogen	Ash	Calcium	Nitrogen	Ash	Calcium	Nitrogen		
Aesculus indica	9.65	4.75	5.86	–	–	–	1.00	0.50	0.50	4225	71.3
Alnus nepalensis	6.20	3.90	2.20	–	–	–	2.44	1.55	0.93	4093	68.2
Dendrobenthamia capitata	7.04	4.08	2.13	2.46	1.41	0.63	0.70	0.40	0.20	4061	62.1
Cornus macrophylla	6.65	3.80	1.99	–	–	–	–	–	–	4361	53.7
Coriaria nepalenis	7.17	3.30	3.53	–	–	–	0.22	0.12	0.09	3991	60.8
Cornuso blonga	3.23	1.34	0.96	–	–	–	–	–	–	4030	23.7
Ilex spp.	8.25	4.65	2.80	2.56	1.48	1.31	4.80	2.69	2.41	4512	129.0
Juglans regia	14.00	6.30	4.50	–	–	–	1.93	0.87	0.60	4125	93.2
Dendrophthoe falcata	0.40	0.20	0.01	–	–	–	9.17	3.77	2.27	3280	55.8
Lyonia oval ia	6.75	2.35	3.36	5.00	2.07	3.35	3.10	1.10	1.94	4245	278.4
Machilus du ei	4.94	2.44	2.73	3.30	1.90	1.96	–	–	–	4371	104.1
Myrica sapida	3.11	1.84	1.86	1.30	0.72	0.76	–	–	–	4446	65.6
Pyrus pashia	0.57	0.31	0.47	–	–	–	–	–	–	3521	21.2
Quercus dilatata	10.0	4.95	3.74	19.58	7.42	7.74	12.54	5.70	5.19	4594	312.6
Quercus glauca	6.93	3.00	3.70	5.74	2.36	2.40	6.60	2.90	2.40	4565	139.5
Quercus incana	36.80	18.20	20.00	20.00	9.60	9.20	28.20	12.30	11.40	4769	685.9
Quercus lanuginose	5.20	2.11	3.20	6.10	2.50	3.00	5.70	2.74	1.75	4799	159.7
Rhododendron arboreum	11.40	5.30	6.00	4.00	1.63	2.45	2.60	1.04	1.70	4537	299.9
Rosa meschata	0.24	0.11	0.23	0.06	0.03	0.07	–	–	–	3163	9.9
Rubus spp.	0.26	0.11	0.32	0.15	0.07	0.16	–	–	–	3329	26.6
Viburnum cotenifolium	4.70	2.50	3.10	1.10	0.60	0.70	0.90	0.40	0.50	3798	100.8
Mean leaf litter	9.40	3.90	5.00	5.90	2.50	2.10	12.60	6.00	3.50	3899	191.9
Total	162.91	79.45	75.69	77.25	34.29	35.83	92.50	42.08	35.38		3014.0

The nutrient return in the present forest was dominated by *Quercus incana* which accounted for 25.6% ash, 27.6% nitrogen and 22.7% stored energy in the total annual litter fall. The second species in order of importance was *Quercus dilatata*, (12.7% ash, 11.6% calcium, 11.3% nitrogen and 10.4% stored energy). The nonleafy litter accounted for 8.4% ash, 7.9% calcium, 7.3% nitrogen and 6.4% stored energy). Among the different seasons, summer accounted for the majority of nutrient return (49% ash, 51% calcium, and 51.5% nitrogen). The importance of season was mainly determined by the quantity of the litter while the importance of species was determined both by the quantity of litter fall and its nutrient concentration (Negi[10]).

As pointed out by Henry[11] and Ovington[12], the nutrients of leaves varies considrably among species. The density and age of the forest which determine the quantity of litter fall also effect the nutrient return. Further, difference in soil nutrient levels effect the nutrient concentration of leaves and hence the nutrient return (Ovington[12]). The edaphic factor have been shown to have a considerable influence on the return of nutrients (Duvigneaud and Denaeyer De Smet[13]).

REFERENCES

1. Brey, J. R. and Gorham E., *Adv ecol Res*, 2 (1964) 101-157.
2. Singh, K. P., *Proc Symp Recent Adv Trop Ecol*, (1968) 655-665.
3. Morrison, I. K., *Can. J For Res*, (1973) 170-179.
4. Gragg, J.B., Carter,A., Leischner, C.,Peterson, E.B., and Sykes, G.N., *Redobiologia, Bd.* 17S (1977)428-443.
5. Killingbuck, K. T. and Wali, M. K., *Oikoz.*, 30 (1978) 29-60.
6. Leith, H., In E. E. Eckardt (ed.) Functioning of Terrestrial Ecosystems at the Primary Production Level. UNESCO, Peris. (1968) 233-242.
7. James, T. D. W. and Smith, D. W., *Can J Bot*, 56 (1978) 1798-1803.
8. Piper, C. S., Soil and Plant Analysis. New York (1944)
9. Misra, R., Ecological Work Book, Calcutta (1968).
10. Negi, K. S., Ph. D. Thesis, University of Kumaon, Nainital (1980) 289.
11. Henry, D. G., *For. Res Note* (1973) 241.
12. Ovington, J. D ; *Ann Bot* N S, 21 (1956) 287.
13. Duvigneaud, P. and Denaeyer. DeSmet, S., In D. E. Reichle (ed.), Analysis of Temperate Ecosystems. Springer Verlag, New York (1973) 199-225.

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Study of UV Radiation Initiated Changes in Aqueous Solution of Citric Acid in the Presence of Ammonia or Nitrogen and in Presence and Absence of Hydrogen

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ABSTRACT

Ultraviolet irradiation (250 W, 40 hr, 2537 A°) of sterilized aqueous solution of citric acid gave fifteen chromatographically distinguishable ninhydrin reactive products whereas nine products were detected on exposure of the identical mixture to UV light both in the presence of nitrogen and hydrogen. Of these a few common products, invariably formed in appreciable amount both in presence or absence of sensitizers were identified as aspartic acid, glycine, alanine and n-aminobutyric acid. It was studied that the nature and yield of resulting products depends upon the period of exposure and the presence or absence of sensitizers in the irradiation mixture.

INTRODUCTION

Earlier studies on photochemical synthesis of amino acids have shown that a variety of amino acids could be synthesised starting from a number of organic precursors. The formation of amino acids and their subsequent combinations have been reviewed by a number of workers [1,4,8 & 11]. But most of the work carried out in this direction is related with the theory of abiogenesis of biomolecules.

The work has been extended[5–7] with a view to find out the prebiological pathways of the formation of some molecules of biological significance starting from a variety of organic substances in the presence and absence of ammonia and intersting results have been obtained using ultraviolet radiation (250 W, low pressure lamp, 2537 A°) under a variety of heterogeneous conditions.

EXPERIMENTAL

Irradiation of the aqueous sterilized solutions of chromatographically pure citric acid (AR, BDH, 100 mg/100 ml) with UV light (250 W) in transparent quartz glass vessels [250 ml] both in the presence and absence of sensitizers, nitrogen and hydrogen and chromatography of the irradiated and control solutions (freed of water in vacuum evaporator) using phenol-water (80:20, wt/vol). n-butanol-acetic acid-water (4:1:1, vol / vol; 9:1:1,vol / vol, 4:1:5, vol / vol, upper phase) and n-butanol-acetic acid-water-pyridine (15:3:12:10 v /vol) as solvent systems were carried out at room temperature (10±4°C)[5].

The irradiation products were located and characterised using ninhydring[10] (0.1 g/100 ml acetone) alloxan[9] (0.2 g/100 ml acetone) and Folin's reagent[2] (0.02% 1-2 naphthaquinone-4-sulphonate in 5% aqueous sodium carbonate) and by comparing with the authentic standards as well as by their dinitrophenylation to DNP deriyatives, The Rf values, coincidence chromatography and fluorescence under ultraviolet light (3650 A°,

black light lamp) were established. The quantitative amounts of the resulting products II, III, V, VII and Ix were determined in universal colorimeter model VI at 570 mu. The UV absorption spectra of the irradiation products were taken in a Higler Spectrophotometer.

RESULTS AND DISCUSSION

Aqueous solutions of citric acid in presence and/or absence of sensitizers on exposure to UV light were investigated by descending, circular and thin layer chromatography and also by following their UV spectura. The Table–1 show that UV irradiation of citric acid and ammonia in presence of hydrogen gave nine products Products I, II and III appeared first (10 hrs) followed by products IV, V, VI, VII, VIII and IX (30 hrs). On prolonging the duration of irradiation period, the percentage yield of the resulting products enhanced appreciably. Uranium oxide in presence of ammonia, hydrogen or nitrogen, during irradiation decreased the yield of n-amino butyric acid and valine while the presence of titanium oxide and zirconium oxide accelerated the products, but the products IX was formed in relatively lower amounts when UV irradiation was effected in presence of nitrogen.

UV irradiation of sterilized aqueous citric acid solutions in presence of ammonia alone gave a new product identified as proline which was not detected in above reaction mixtures using either nitrogen or a mixture of ammonia and hydrogen. Products (II, III, V, VII and IX) formed comparatively in appreciable yield and tentatively characterised as aspartic acid (II), glycine (III), alanine (V), n–aminobutyric acid (VII) and valine (Ix) respectively due to resemblance of their characteristic colour reaction Table–1, mobility factors, coincidence chromatography and dinitrophenylation reaction with those of the authentic reference standards, were further confirmed by their absorption spectra All these products showed single sharp absorption bands between 1900 & 3000 A° having maxima between 2000 & 2200 A°. Perfect coincidence between spectra of the authentic standard and the photoproducts was observed. The characterisation and identification of the products were done by different colour tests and Rf value as shown in the table.

TABLE 1

Properties of the products of UV irradiation on aqueous solution of citric acid under heterogeneous conditions.

Reagents	Main products of irradiation								
	I	II	III	IV	V	VI	VII	VIII	IX
Colour with ninnydrin	LB	DV	BV	—	V	—	V	V	DV
Isatin	—	LPr	PrV	IB	P	—	P	—	LR
Alloxan	B	LPr	LPr	—	R	—	OR	LB	LR
Folin's reagent	—	Rh	VW	—	BIG	—	G	—	Gr
Rf* DNP derivatives	—	0.04 (mp.183°C)	0.43 (mp.200°C)	—	—	—	0.3 (mp.130°C)	—	0.68 (mp.133°C)
	W	VW	P, G	VW	VW	VW	VW	W	VW
Solubility in ether	nil	nil	nil	nil	nil	nil	nil	nil	nil
Rf values*	0.09	0.13	0.16	0.21	0.26	0.31	0.36	0.41	0.46
Yield% (acid + H_2O + AmOH + H_2)	T	0.02	0.02	T	0.01	T	0.015	T	0.02
Yield% (acid + H_2O + N_2)	T	0.02	0.025	T	0.005	T	0.02	T	0.005
Amino acid identified	—	aspartic acid	glycine	—	α-alanine	—	n-amino butyric acid	—	valine

*Using solvent system n–butanol–acetic acid–water (4:1:1) at temperature 10±4°C.

V, violet; B, blue; Y, yellow; P, pink; O, orange; R, red; W, white; Bl, bluish; Pr, purple; L, light; D, dark; Gr, greenish; Rh, reddish and —, not detected; T, trace amount.

REFERENCES

1 Dal, W. M, Davice, J. V. and Gilbert, C. W. *Biochem. J.* 45—93 (1949) 543.
2. Giri, V. K and Nagabhusanum, A., *Naturowissenschaften.* 39 (1952) 548.
3. Hais, I. M. and Macek, K paper Chromatography, cademic Press Inc. London (1963) 448, 819.
4. Oro, J., *Ann. New York.* Acad. Sci., 108 (1963) 464.
5. Pathak, M. D., Pant, H. C. and Mahendra Pal, *Ind. J. Biochem* 5 (1968) 65.
6. Perti, O. N., Bahadur, K. and Pathk, H. D. *Indian J. Appl Chem.* 25 (1962) 10.
7. Perti, O. N., Bahadur, K. and Pathak, H. D., *Biokhimia* 27 (1962) 708.
8. Ponnamperuma, C., *Science,* New York 147 (1965) 1512.
9 Saifer, A. and Oreskes, I., *Analyst. Chem.* 20 (950) 501.
10. Smith, I. Chromatography and Electophoretic Techniques, Inter Science Publisher, New York, 1960, 1—183.
11. Vaidyanathan, C. S., Kalyankar, G. D. and Giri, K. V. *Procd. Natl. Acad. Sci. India* 24 (1955) 285.