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NITROGEN AND PHOSPHOROUS CHEMISTRY IN THE FOLIAR TISSUE OF SCHIMA WALLICHII IN THE SUBTROPICAL ECOSYSTEM OF NORTHEAST INDIA.

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ABSTRACT The aim of the present investigation is focussed on the Nitrogen and phosphorus chemistry of foliar tissues under the influence of climate in the warm moist subtropical climate. Being one of the dominant species in the region, *Schima wallichii* (DC.) Korth is selected as the model species for the analysis. It is found that temperature factor impacted most than other climatic factors in the variability of traits.

KEYWORDS :

Introduction

Plant growth and productivity are determined by Nitrogen (N) and Phosphorous (P) concentration, particularly in the foliar leaf. Optimum Plant height, root morphology, chlorophyll content is achieved at the adequate supply of N and P (1). Plant species require different concentration of nutrient mainly N and P, amidst N required in largest quantities (2) act as a primary nutrient for growth, cell division, reproduction, plant metabolism (3,4). The photosynthesis rate is also related with the foliar nutrient mainly N & P and the differential concentration among and between the species is related to the foliar concentration of nutrient mainly N reflecting changes in enzyme concentration (5). Mineralization including nitrification and soil nutrients as well as climatic factors like temperature, irradiance, land use history etc. could limit many ecosystem processes (6,7). Climatic factor, nutrient availability and species traits responsible for the variation in the canopy foliar N and P concentration.

Considering the biochemical role of N and P, it is necessary to balance the uptake of N and P through assimilation, losses, turnover, leaching etc (8). Plants have adopted physiological traits to regulate and maintain the ecological processes. However variation in the accumulation pattern exist, being observed in the active tree tissues such as leaves in the tropical forest (9). Therefore study about the nutrient dynamics in the active tissues is a precondition for predicting the ecological sustainability of an ecosystem.

With the increase in temperature and subsequent warming affect the ecological processes including carbon sequestration. Forest, being a carbon sink and provides the essential elements for sustaining life, the study about the nutrients dynamics of different components, particularly leaves, twigs and fruit, mainly N and P of the commonly distributed species is an utmost importance in the ecosystem analysis. In the subtropical forest ecosystem of the region, *Schima wallichii* (DC.) Korth is observed as one of the most dominant species, they have rapid decomposition rate (10) and sequester carbon at a faster rate. Therefore, the adequate supply of N and P is essential for plant metabolism, growth and reproduction. The nutritional quantity in the foliar tissue could help in the determination of N and P availability in the ecosystem. Thus, the present work is focussed on the study of nitrogen and phosphorus chemistry of *Schima wallichii* in the foliar tissue mainly leaves, twigs and fruits. Such a study has been lacking in the subtropical forest ecosystem of the region. Therefore, the present investigation will help in the prediction of ecosystem processes and formulation of restoration strategy.

Material and Method

The state, Manipur is located at 23°80'° N and 25°68' N latitudes and 93°03' E and 94°78' E longitudes in the northeastern corner of India and on the Indo-Myanmar hotspot region of the world. *Schima wallichii (DC.)* korth have been reported as one of the dominant species in the subtropical ecosystem of the region. The climate of the region is conducive to the luxuriant growth of vegetation with a mean annual rainfall (PPT) of 138.73 ± 146.98 mm and mean annual temperature (MT) of 27.97 ± 2.91°C (± std**,** N=12 ie from April 2013 – March 2014**).** For the present investigation the foliar tissue were collected seasonally from the three different sacred groves located in the subtropical region namely in three different valley districts of Manipur, the SG-I, the Chajinglakpa Sacred Grove (24°43'13.64″ N and 93°55'50.13″E), SG-II, the Chaning Lairembi Sacred Grove (24°43'49.46″N and 93°50'31.69″E), SG-III, the Kalika lairembi Sacred Grove (24°51'8.79″N and 94°04'32.60″E). The mean annual soil temperature (ST) and soil moisture (SM) was 21.76 ± 4.70°C and 25.13 ± 5.02 % (± std) for all the sampling groves. The collected leaves were mixed and processed for further elemental analysis. Total elemental nitrogen was determined following acid digestion Kjeldahl procedure and alkali distillation of the digested sample using Kjeltech TM 2000 series. Total phosphorus was determined by molybdenum-blue method (11) after digesting the sample with the tri-acid mixture of (HNO_3:H_2SO_4: $HClO_4$) in 10:4:1.

For statistical analysis, One-way ANOVA was used to compare the characteristics variance in N and P among the different component taken. Multiple correspondence analysis was applied to find the relationship among the categorical variable when taken as one set using SPSS 23.

Result and Discussion

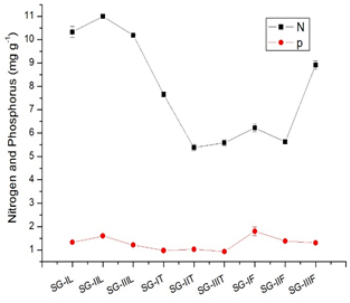

Fig.1: Seasonal-mean of Nitrogen and Phosphorus concentration in different components of foliar tissues viz leaf, twig and fruit of *Schima wallichii* (± indicates SE & uppercase suffix L, T, F against the SGs in the x-axis indicates leaf, twig and fruit respectively).

Tab. 1. One way ANOVA of selected components viz leave, twig and fruit for N and P concentration

ANOVA								
Source of variation				Sum of Squares	df	Mean Square	F	P value
N	Between Groups	(Combined)	127.134	2	63.567	39.763	.000	
		Linear Term	Contrast	77.006	1	77.006	48.170	.000
			Deviation	50.127	1	50.127	31.356	.000

	Within Groups			52.755	33	1.599		
	Total			179.889	35			
P	Between Groups	(Combined)		1.807	2	.904	14.337	.000
		Linear Term	Contrast	.058	1	.058	.920	.345
			Deviation	1.749	1	1.749	27.755	.000
	Within Groups			2.080	33	.063		
	Total			3.887	35			

* The mean difference is significant at the 0.05 level.

Tab.2: Percentage (%) of variance explained by Dimension 1 and 2.

Model Summary				
Dimension	Cronbach's Alpha	Variance Accounted For		
		Total (Eigenvalue)	Inertia	% of Variance
1	.969	7.841	.784	78.407
2	.935	6.292	.629	62.917
Total		14.132	1.413	
Mean	.954[a]	7.066	.707	70.662
a. Mean Cronbach's Alpha is based on the mean Eigenvalue.				

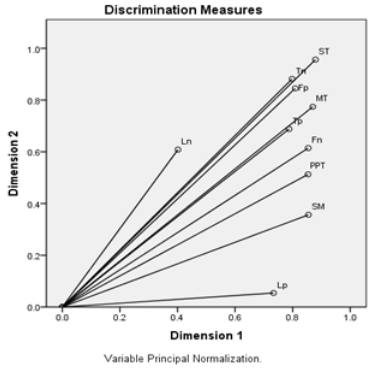

Fig. 2: Multiple Correspondence analysis showing the relationship between the categorical variables, here all the variables were set in one set. The graph showed that all the variables were interrelated and influence in an asymmetric manner. ST, being farther away from the origin net to MT indicate that the temperature factor is most influential (subscript N and P indicated nitrogen and phosphorus for leave (L), twig (T), fruit (F) respectively.)

The foliar nitrogen (N) was ranged from 10.19 ± 0.02 mg g^{-1} to 10.99 ± 0.24 mg g^{-1} for leave, 5.38 ± 0.13 mg g^{-1} to 7.65 ± 0.10 mg g^{-1} and 5.62 ± 0.07 to 8.19 ± 0.18 mg g^{-1} for twig and leave respectively (Fig.1). Similarly, the phosphorus (P) concentration of the selected species varied among the habitat. It was ranged from 0.92 ± 0.01 mg g^{-1} to 1.56 ± 0.02 mg g^{-1} for all the selected components (Fig.1). The significant variation was observed between and within the group for the selected components (Tab. 1). The elemental concentration of N and P was maximum in leaves followed by fruit and twig. This might be due to physiological stoichiometry related with photosynthesis and re-translocation of nutrients occur at twig so that internal cycling of nutrient counterbalance the limiting effect of N and P in the nutrient-poor tropical region which is consistent evergreen broadleaf forests and deciduous broadleaf forests with the reported study (12).

The dimension analysis showed 78.41 % of variance showed by the dimension 1 among the categorical variables taken for the present analysis (Tab.2) and the derived multiple correspondence analysis showed the role of climatic factors like ST, MT, PPT etc. in the foliar N and P chemistry of *Schima wallicii* (Fig.2). The effect of environmental factors on plant stoichiometry was also reported (13, 14) which is concomitant with the present finding. However the poor distance between PPT, SM with the nutrient trait i.e, N and P of leave indicate the species adapt in a moist nutrient-poor tropical soil as PPT reduces the soil nutrient by increasing leaching action rather than retention however made availability of optimum SM for necessary metabolic action and enzyme regulation (15). Thus, the leave has the potentiality of carrying out their metabolic activity at the optimum level in the existing climatic condition.

Conclusion

Here, it is concluded that the plant N and P chemistry in the subtropical forest is influenced by the climatic factor. Temperature factors accounted mostly in the nutrient dynamics of foliar tissue. Therefore, in the warming climate, the temperature factor should be focussed so that the coupling between plant and soil as well as climate exist in a sustainable way. This study contributes to the further study of species metabolism regarding growth and nutrient dynamics under the climatic or environmental change.

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