FOREST RESEARCH BRANCH

PROGRESS REPORT

TOTAL NITROGEN IN THE HUMUS LAYER AND ASSOCIATED LESSER VEGETATION AS RELATED TO SITE QUALITY

(Project Q-77)

by

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INTRODUCTION

A previous publication (Gagnon et al. 1958) has shown the inherent capacity of some forest plant leaves to contain in their tissues different quantities of mineral elements irrespective of the quantity stored in the humus layer where they grow. At that time nitrogen had not been studied because the functions of nitrogen, although coordinated and interdependent with those of other elements, are so different that they cannot be discussed collectively. This paper presents results obtained with nitrogen.

In this report, the humus layer and associated lesser vegetation of only two site types, Hypnum and Sphagnum-Rubus (Linteau, 1955), were studied. These site types are typical of the northeastern coniferous section (B-1) of the boreal forest region (Halliday, 1937), and according to Linteau (1955) support pure black spruce stands of productivity classes II and IV respectively.

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LITERATURE REVIEW

Considerable basic information on N has been obtained through research since World War II, but most of the studies refer to agricultural crops. Although increased attention has been given during this last decade to relationships between tree growth and leaf N, relatively little information is available concerning the nitrogen status of lesser vegetation.

According to Lutz and Chandler (1947) certain herbaceaous plants may be regarded as useful indicators of nitrification in forest soils. Vizir (1956), Bernier and Roberge (1962) have reported that different forest litters have different influences upon the nitrogen mineralisation. Van Camp (1948) suggested that lesser vegetation may be an important source of nitrogen for tree growth, and Scott (1955) attributed differences in nitrogen content of litter primarly to the differing subordinate vegetation. Bonnevie-Svendsen and Gjems (1957) found that litter from ground vegetation contained appreciable quantities of nitrogen. Weetman (1961), reviewing the literature on the nitrogen cycle in temperate forest stands, mentioned that the quantity of nitrogen returned to soil by ground vegetation varies considerably with stand density and tree species.

All these studies show the importance of lesser vegetation in the nitrogen cycle in forest but none is directly concerned with the possible relationship that might exist between the nitrogen content of the humus layer, the site quality and the concentration of nitrogen in leaves of associated lesser vegetation. Such information will bring more light to the role and the influence of lesser vegetation upon the development of stands.

MATERIAL AND METHODS

Field Procedure

Samples of the humus layers and of plant tissues were collected during September 1959, 1961 and 1964 (after the growing season) in widely separated parts of the Quebec Laurentides Park located in the boreal forest region (B-1) (Halliday, 1937). Samples were obtained from two vegetation types, namely, Hypnum and Sphagnum-Rubus after Linteau (1955), differing in their ecological structures and representing productivity classes II and IV respectively. Humus (H layer) samples gathered at random from 10 different locations in each of several 1/10 acre areas located within each vegetation type were mixed together for analysis. Only healthy leaf material, gathered over the entire surface of a delineated area, was used for analysis. Immediately after collection, humus and plant leaf samples were air-dried.

Laboratory Procedure

In the laboratory, the humus layer and plant leaves were oven-dried at a temperature of 105°F during a twenty-four hour period, pulverized and stored in glass bottles for analysis.

The total nitrogen was determined for one gram of oven-dried material by the Kjeldahl method (Bremner and Shaw, 1958).

RESULTS AND DISCUSSION

Results of the nitrogen analyses of humus layers and lesser vegetation are presented in Table I where data, derived from two different vegetation types: Hypnum (Class II) and Sphagnum-Rubus (Class IV) are statistically analysed. The intermediate productivity class III was not sampled in this study in the expectation that there would be only small differences in these characteristics even among extremes.

The humus layer

No significant differences were found between the nitrogen content in the humus layer of site class II and site class IV. This loo.s paradoxical, especially as the nitrogen content of the poorest site, even though not statistically significantly higher is nevertheless greater. Similar results have been obtained by Linteau (1955) who found a close relationship between total nitrogen content in the humus layer and productivity classes I, II and III but not with class IV represented by the Sphagnum-Rubus type which decomposes very slowly and is characterized by accumulation of organic matter. According to Ovington (1957) and Weetman (1962), on sites where organic matter accumulates due to poor decomposition conditions, nitrogen is immobilized in the humus layer resulting in decreased productivity of the forest stands.

The lesser vegetation

The inherent capacity of the various lesser forest plants to contain in their tissues different quantities of nitrogen, irrespective of site quality, is partially shown in Table 1. Out of 10 species studied on both types, two, Rubus chamaemorus and Calliergonella schreberi behaved differently in concentration of nitrogen in their tissues. Rubus chamaemorus was especially abundant in the Sphagnum-Rubus type whereas Calliergonella schreberi made up most of the moss strata of the Hypnum type. Except for sphagnum which was associated with the Sphagnum-Rubus type and found in the Hypnum type only in small patches, the other plants were not generally abundant on the two vegetation types studied.

The reason for differences in the concentration of nitrogen in tissues of Rubus chamaemorus and of Calliergonella schreberi, could be explained in terms of adaptation to site. This explanation however, would not be too convincing because sphagnum moss, which is also associated with the Sphagnum-Rubus type, does not contain more nitrogen in its tissues when growing on Sphagnum-Rubus type than when growing on Hypnum type. This point must be examined further before discussion. It should be mentioned that for Rubus chamaemorus, with 13 degrees of freedom, the "t" value reaches the 95% level whereas for Calliergonella schreberi with 24 degrees of freedom, the "t" value hardly exceeds 80% probability.

It is noticeable that foliage of herbs and shrubs contained more N than the foliage of mosses. Thus, mosses would have to be very abundant to significantly contribute to site enrichment through decomposition.

1965 FUTURE WORK

In order to decide whether or not the concentration of nitrogen in tissues of lesser vegetation varies with site quality, the three species in question, Rubus chamaemorus, Calliergonella schreberi and Sphagnum species will be sampled in additional locations in as short a period as possible at the end of the 1965 growing season.

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APPENDIX

Table 1. Total nitrogen in the humus layer and associated lesser vegetation of two different site classes: Hypnum (site class II) and Sphagnum-Rubus (site class IV)

Humus layer and species	Hypnum type (site class II)		Sphagnum-Rubus type (site class IV)		Significance
	No. of samples	nitrogen %*	No. of samples	nitrogen %	
Humus layer	(12)+	1.38±.07	(12)+	1.45±.14	Not sign.
Herbs					
Cornus canadensis (L.)	(17)	1.92±.06	(15)	1.81±.03	Not sign.
Oxalis montana (Raf.)	(11)	3.24±.19	not found		
Rubus chamaemorus (L.)	(7)	2.50±.07	(8)	2.95±.14	Sign. at 95% level
Dwarf Shrubs					
Chiogenes hispidula (L.) T. & G.	(14)	1.26±.02	(12)	1.21±.01	Not sign.
Kalmia angustifolia (L.)	(9)	1.80±.12	(12)	2.01±.08	Not sign.
Ledum groenlandicum (Oeder)	(8)	1.79±.06	(14)	1.78±.03	Not sign.
Vaccinium pensylvanicum (Lam.)	(12)	2.48±.07	(12)	2.37±.07	Not sign.
Mosses					
Calliergonella schreberi (BSG)	(13)	1.08±.05	(13)	.94±.04	Sign. at 80% level
Hylocomium splendens (Hedw.)	(12)	.98±.04	(9)	.94±.03	Not sign.
Hypnum crista-castrensis (Hedw.)	(10)	1.04±.08	(10)	.92±.05	Not sign.
Sphagnum sp.	(13)	.91±.06	(13)	.86±.02	Not sign.

* Expressed as means ± S.E.

\+ Degrees of freedom: (n-1)+(n-1)