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Determining Rate of Litter Decomposition of *Alnus subcordata* in Asalem and Vaz Regions by C/N Index under Laboratory Conditions

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Abstract: In order to determine the rate of litter decomposition of *Alnus subcordata* at two alder stands, litters from Vaz and Asalem with different parent material were collected in autumn. Litters of each region, put in four vases for 7 months in laboratory conditions. Sampling were taken within 21 days. Then nitrogen and carbon was measured in each interval. On the first day, the comparative study between two regions showed that there exits no significant difference between C and N contents of litters. The amount of N was 2.49 and 2.62% in litter of Vaz and Asalem, respectively. The amount of C was 43.4% in Vaz and 39.7% in Asalem. Rate of carbon variation showed no significant difference in two regions. Rate of nitrogen and C/N variation showed significant difference in two regions. C/N of litter reduced from 17.38 to 10.35 and from 15.12 to 10.67 in Vaz and Asalem, respectively.

Key words: Litter decomposition, carbon, C, nitrogen, N, C/N, alder

INTRODUCTION

In a forest ecosystem, litter production is mainly expressed as a massive contribution of dead organic matter that accumulates on the ground^[1]. Release of nutrients from decomposing litter is an important internal pathway of nutrient flux in forested ecosystems. The release of nutrients from decomposing litter, controls their subsequent availability for plant uptake, or loss from the ecosystem and affects ecosystem primary productivity^[2]. Then with knowledge of rote of litter decomposition, can find input of nutrient in forest ecosystem.

Rate of decomposition is controlled by litter quality, chemical and physical conditions and soil organic decomposer^[3]. Different species have different nutrient release patterns, which are related to litter quality^[4]. The C:N ratio is accepted as a general index of litter quality^[5].

In decomposition processes of organic matter, microorganisms is caused exit of carbon and consequently C:N ratio is decreased. Nitrogen play important role in decomposition of organic matter, so that high concentration of nitrogen in fresh leaf litter is caused to accelerate litter decomposition^[6].

In genus of Alder (*Alnus*), with attention to be a Stabilizer of nitrogen, amount of nitrogen in leaves is high, that is resulted to accelerate litter decomposition^[7].

There are several record of nitrogen in litter of alder, for example 2.72% in *A. acunnata*^[8] and 2.53% in

A. rugosa^[9]. But there is not any record about amount of nitrogen, carbon and rate of litter decomposition in *A. subcordata*.

The objective of this study was to determine the rate of leaf litter decomposition and to compare it between leaf litter of two sites (Asalem and Vaz) in *Alnus subcordata* by C: N index under laboratory conditions.

MATERIALS AND METHODS

Leaf litter collection: In order to determine effects of soil conditions on litter quality, litters were collected from Asalem and Vaz sites, with different parent material in October of 2001. Parsel No. 105 at Kylehsara Forest and district No. 2 at Vaz Research Forest were selected in Asalem and Vaz, respectively.

Parsel No.105 has placed on acidic soil (pH = 4.5) on Granoudiurit^[10], but district No. 2 has placed on calcic soil on limestone^[11].

Two alder stands were selected at two regions. Fresh leaf litter was collected from forest floor in autumn by random. Leaf litter was put in bag and was moved to laboratory.

Leaf litter preparation and sampling: Litters of each region, was put in four vases for 7 months. The vases were hold at 15- 20°C and 25% moisture. Sampling was taken within 21 days, 30 g sample each time. Samples was

hold at room temperature (15-20°C) for 48 h, then was dried at 60°C for 48 h^[12].

Chemical and data analysis: Total nitrogen and carbon were determined using the Kjeldal method and Walkley and Black method, respectively. Data was analyzed using SPSS package.

RESULTS

Carbon: The content of C decreased from 43.4 to 35.02% in Vaz and from 39.7 to 34.5% in Asalem in 210 days. Rate of carbon variation showed no significant difference in two regions (Table 1) ($p > 0.05$). Rate of carbon variations was decreased in two regions at duration (Fig. 1).

Nitrogen: The content of nitrogen increased from 2.49 to 3.57% in Vaz and from 2.62 to 3.23% in Asalem in 210 days. Rate of nitrogen variation showed significant difference in two regions (Table 2)($p < 0.05$). Data of nitrogen was transformed by $\text{Arcsin}((N/4) + 0.035)$. Rate of nitrogen variations was increased in two regions at duration (Fig. 2).

C: N Ratio: C/N of litter reduced from 17.38 to 10.35 and from 15.12 to 10.67 in Vaz and Asalem, respectively. Rate of C:N variation showed significant difference in two regions. (Table 3)($p < 0.05$). Rate of C:N variations were decreased in two regions at duration (Fig. 3).

DISCUSSION

Mineralization of nitrogen can show with two patterns., initial net immobilization followed by net mineralization in later stages and net mineralization with time.

Residues with C:N greater than about 30, follow pattern 1, on the other hand, residues with C:N ratios below about 20, follow pattern 2^[13]. Therefore, with attention to primary C: N in leaf litter of *Alnus subcordata*, (17.3 for Vaz and 15.2 for Aslem), rate variation of nitrogen and C: N ratio follow second pattern.

During net mineralization, amount of NH_4^+ and NO_3^- increased, then sufficient nitrogen is made available for microorganism activity and this have been caused fast decomposition on first 50 days.

C/N of litter reduced from 17.38 to 11.15 on 1st day to 9th week respectively in litter of Vaz, then it attain to 10.35 during other 5 months. This ratio reduced from 15.12 to 11.1 on 1st day to 9th week, respectively in litter of Asalem, then it attain to 10.67 during other 5 months.

Table 1: Comparison of carbon percent at different days in two sites

Site	Time (days)		
	1	105	210
Vaz	43.4±1.70 ^a	33.8±0.09 ^a	35.0±0.66 ^a
Asalem	39.7±0.66 ^b	35.7±0.06 ^a	34.5±2.02 ^a

Table 2: Comparison of nitrogen percent at different days in two sites

Site	Time (days)		
	1	105	210
Vaz	2.49±0.07 ^a	3.29±0.09 ^a	3.57±0.08 ^a
Asalem	2.62±0.12 ^a	3.00±0.06 ^b	3.23±0.06 ^b

Table 3: Comparison of C/N ratio at different days in two sites

Site	Time (days)		
	1	105	210
Vaz	17.38±1.06 ^a	10.28±0.59 ^b	10.35±0.15 ^b
Asalem	15.12±0.87 ^b	11.90±0.63 ^a	10.67±0.43 ^a

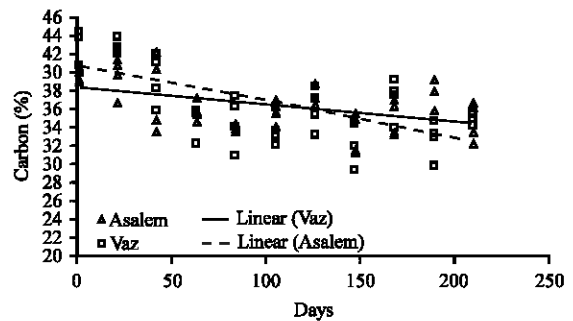


Fig. 1: Rate of carbon variation in leaf litter of two regions

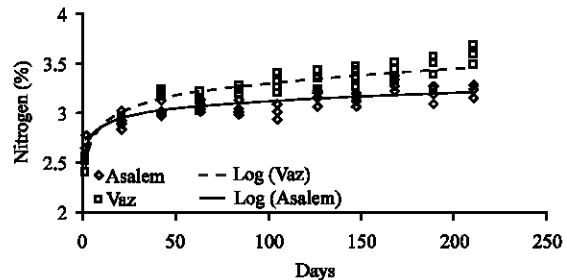


Fig. 2: Rate of nitrogen variation in leaf litter of two regions

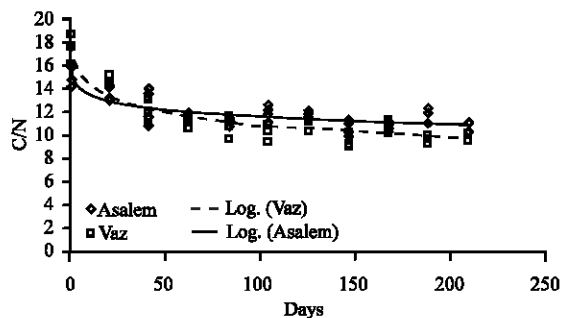


Fig. 3: Rate of C:N variation in leaf litter of two regions

Therefore, we can separated two stages in leaf litter decomposition of alder:

- Initial stage of decomposition, that occurs fast.
- Later stage of decomposition that occurs gradually.

Canhoto and Graca^[7] in their study on *Eucalyptus globulus*, *Alnus glutinosa*, *Castanea sativa* and *Quercus faginea*, reported that leaf litter processing was a two step process with an initial rapid weight loss, followed by a more gradual weight loss.

The decomposition of litter to humus can be divided into different stages^[14]. The decomposition of fine litter can be divided into three phases. First phase is fast and lasts only few months due to environmental conditions and litter quality. The second slow decomposition phases, lasts a few years and the third metastable phases last several decades^[15]. In first phase, litter with high quality and high nitrogen, is decomposed very fast.

In similar conditions, amount of carbon in litter of Vaz decreased more than litter of Asalem. Difference in litter quality (lignin, cellulose and hemicelluloses) could cause this, because this component is decomposed with different rate.

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