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Determination of the Rate of Litter Decomposition and Dynamic of Carbon, Nitrogen and Phosphorus of *Fagus orientalis* in Asalem and Vaz Regions

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In order to determine the rate of litter decomposition of *Fagus orientalis* at two beech stands, litters from Vaz and Asalem with different parent material were collected in autumn. Litters of each region, put in four vases for 357 d in laboratory conditions. Sampling was taken within 21 d. The nitrogen, carbon and phosphorus were measured in each interval. On the first day, the amount of N was 0.73 % and 0.81 % and phosphorous was 817.5 mg/kg and 420 mg/kg in litter of Vaz and Asalem respectively. The amount of C was 43.4 % in Vaz and 41.6 % in Asalem. Rate of carbon variation showed no significant difference in two regions. Rate of nitrogen and phosphorus variation showed significant difference in two regions. C/N of litter reduced from 59.95 to 32.8 and from 47.7 to 28.7, C/P of litter reduced from 531 to 355 and from 989 to 479 in Vaz and Asalem, respectively.

Key Words: Litter decomposition, Carbon, Nitrogen, Phosphorus, *Fagus orientalis*.

INTRODUCTION

The recycling of nutrients contained in litter is an important aspect of ecosystem dynamics and the regulation of rates and timing of nutrient release plays an integral role in ecosystem functioning[1]. The bulk of the above-ground annual net primary productivity of most forest ecosystems is transferred directly to the decomposer subsystem *via* litter fall[2,3]. Therefore, the patterns of decomposition of foliar litter and subsequent nutrient release are important determinants of forest ecosystem function.

The decomposition of litter is influenced by the substrate quality, the physical-chemical environment and the decomposer organisms[2]. Physical-chemical conditions include both climate and soil parent material, which influence litter quality. Under laboratory conditions, where much of the environmental variability encountered in the field can be factored out, forest floor materials from different sites and associated microbial communities, emerge as important variables in rates of litter decomposition[4-6].

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A few studies have systematically investigated intraspecific variation in leaf and litter quality across soil types[7]. Sanger *et al.*[8,9] found changes in hemicellulose and lignin constituents of needle from Scote pine (*Pinus sylvestris*) growing in soils with different exchangeable concentrations. Sariyildiz and Anderson[6] showed that beech (*Fagus sylvatica* L.) and oak (*Quercus robr* L.) growing in three different soil types showed significant variation in the quality and decomposition rates of leaf litters. Hosseini and Azizi[10] showed that hornbeam (*Carpinus betulus*) growing on two different soil types showed significant variation in decomposition rates of leaf litters.

EXPERIMENTAL

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. 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[11], but district No. 2 has placed on calcic soil on limestone[12].

Two beech 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 357 d. The vases were hold at 15-20 ºC and 25 % moisture. Sampling was taken within 21 d. Each time, the sample was taken off 30 g from each cases. Samples were hold at room temperature (15-20ºC) for 48 h and dried at 60ºC for 48 h[13].

Chemical and data analysis: Total nitrogen and carbon were determined using the kjeldal method and Walkley & Black method respectively. Phosphorus was determined by spectrophotometer method. Data was analyzed using SPSS package.

RESULTS AND DISCUSSION

Carbon contents decreased from 43.4 to 37.9 % in Vaz and from 41.6 to 40.4 % in Asalem in 357 days. Rate of carbon variation showed no significant difference in two regions ($p > 0.05$). Rate of carbon variations was decreased in two regions during this duration (Fig. 1).

The content of nitrogen increased from 0.7 to 1.26 % in Vaz and from 0.9 to 1.5 % in Asalem in 210 days. Rate of nitrogen variation showed significant difference in two regions ($p < 0.05$). Data of nitrogen was transformed by: log (N-0.6). Rate of nitrogen variations was increased in two regions during this duration (Fig. 2).

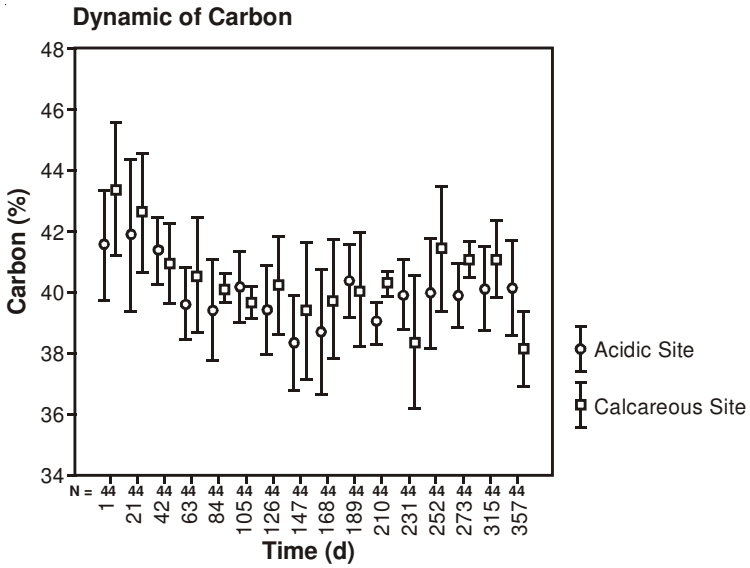

Fig. 1. Rate of carbon variation in leaf litter of two regions

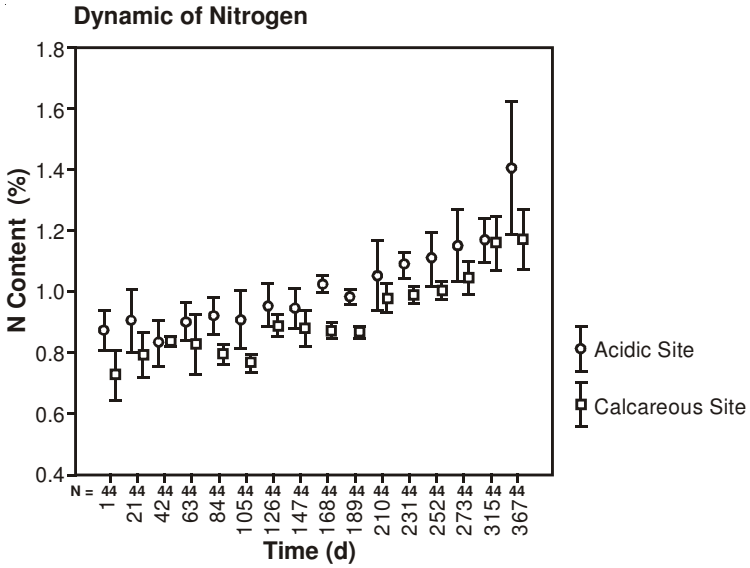

Fig. 2. Rate of nitrogen variation in leaf litter of two regions

The content of phosphorus increased from 817.5 to 1105 mg/kg in Vaz and from 420 to 842.5 mg/kg in Asalem in 357 days. Rate of phosphorus variation showed significant difference in two regions ($p < 0.05$). Rate of phosphorus variations was increased in two regions during this duration (Fig. 3).

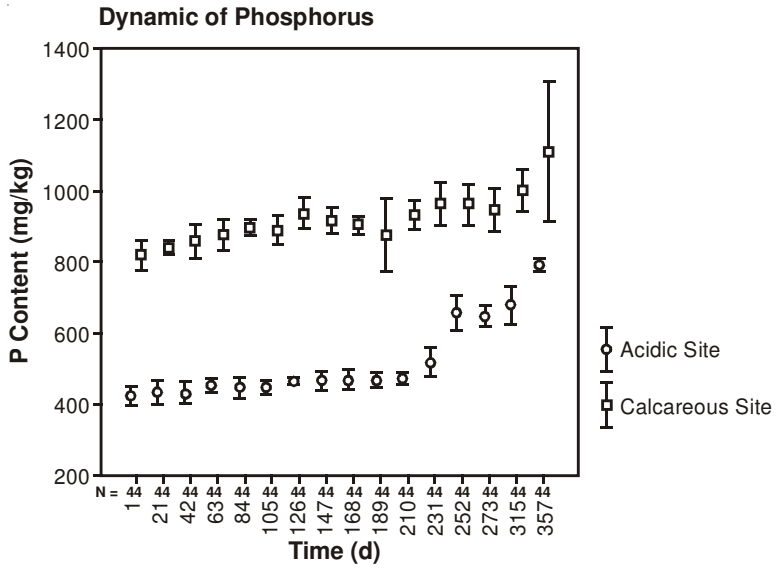

Fig. 3. Rate of phosphorus variation in leaf litter of two regions

C:N Ratio: C/N of litter reduced from 60.0 to 32.8 and from 47.7 to 28.7 in Vaz and Asalem, respectively. Rate of C:N variation showed significant difference in two regions ($p < 0.05$). Rate of C:N variations were decreased in two regions at duration (Fig. 4).

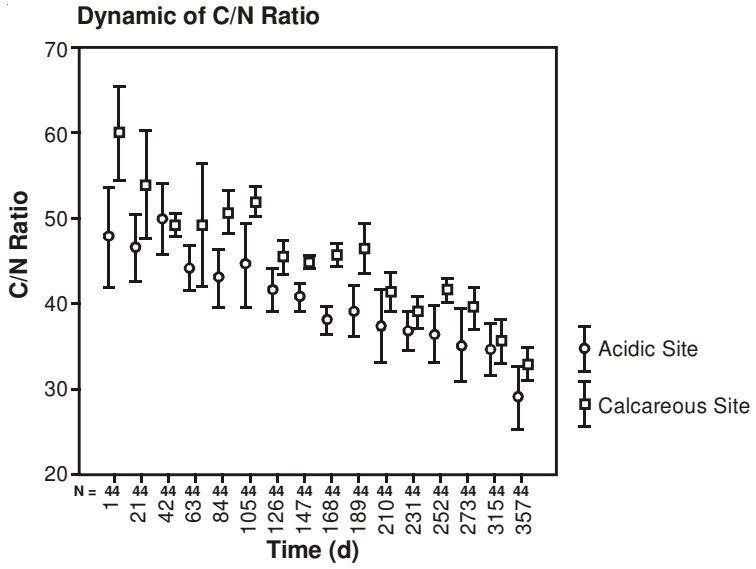

Fig. 4. Rate of C:N variation in leaf litter of two regions

C:P Ratio: C/P of litter reduced from 531.2 to 346.3 and from 989.9 to 508.1 in Vaz and Asalem, respectively. Rate of C:P variation showed significant difference in two regions ($p < 0.05$). Rate of C:P variations were decreased in two regions at duration (Fig. 5).

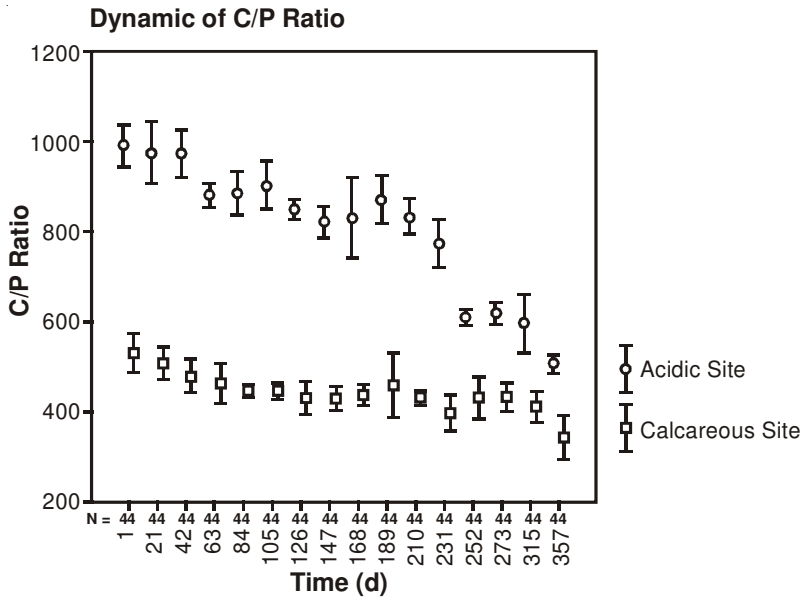

Fig. 5. Rate of C:P variation in leaf litter of two regions

The decomposition of litter to humus can be divided into different stages[14]. The decomposition of fine litter can be divided in three phases. The decomposition rate in the first phase is fast, lasts only few months and is 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]. Third phase theoretically begins following the attainment of a critical C/N ratio. The critical C/N ratio at which mineralization begins may vary with litter type and different soil- litter systems[16].

Mineralization of nitrogen can show with two patterns: 1) Initial net immobilization followed by net mineralization in later stages, 2) Net mineralization with time

Residues with C:N greater than 30, followed the pattern 1, on the other hand, residues with C:N ratios below about 20, followed the pattern 2[17]. Therefore, with attention to primary C:N in leaf litter of *Fagus oreintalis*, (60.0 for Vaz and 47.7 for Aslem). Rate variation of nitrogen and C:N ratio follow first pattern.

During the immobilization phase C/N ratios of litter of both sites decreased. The C/N ratios of litter had reduced to 32.8 and 28.7 in litter of Vaz and Asalem, respectively, which is within the range where net N mineralization would be expected to occur[18,19].

Initial C/P ratios of litter were 531.2 and 989.9 in Vaz and Asalem, respectively and had decreased to 346.3 and 508.1, respectively, by the end of the study. Litter of Vaz appeared to show any consistence net release of P by the end of the study. This may indicate that a critical C/P ratio had not yet been obtain in litter of Asalem. Studies at other forest sites have indicated critical C/P ratio between 360 and 480[18].

Increased in relative nutrient concentration during the decomposition may be explained, in part, by microbial incorporation of nutrients released from litter as carbon is mineralized[20].

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