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Original Research Article

Effect of Litter Placement to Decomposition Rate of *Juglans regia* L. Leaf Litter

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Abstract: Litter decomposition is a mechanism that provides organic matter and carbon cycles in ecosystems. As most of the litter layer consists of plant litter in terrestrial ecosystems, decomposition of plant material is important. This study focuses on effect of litter placement to decomposition rate. *Juglans regia* L. leaf litter were used as study materials. In order to examine, decomposition litter bag technique was used. Litter bags were fastened three different soil depths (0, 5 10 cm depths). The decomposed litter bags were collected in March (three months later), April, May and June. Remaining dry weights, mass loss (%), daily decomposition rate and k values were calculated. According to results, decomposition parameters generally varied with soil depth in all examined months. The decomposition rate also varied according to months. Considering all results completely, this study showed that except first three-month period the maximum decomposition occurred at 10 cm depth and it was followed by 5 and 0 cm depths. It was thought that variation in decomposition rate based on soil depth and months may be caused by differences in temperature, moisture, decomposers flora and fauna in soil depths and stages of decomposition. This study showed that decrease in decomposition rate based on soil depth may be valid for deeper soil profiles. In upper layers of soil, decomposition rate may increase in buried litter depending on land characteristics such as climate and soil texture.
Keywords: Decomposition, *Juglans regia*, litter placement, soil depth

INTRODUCTION

Litter decomposition process is one of the most important mechanisms in ecosystems, which provides organic matter and carbon cycles by transforming organic substances into the simple forms [1]. Decomposition of litter is also important for soil structure and conservation because this process plays role on soil temperature and humidity, microbial activity, soil animals and plant germination. Litter decomposition is a complex mechanism which consists of several biological, chemical and physical processes [2, 3]. Three mechanisms are involved in decomposition process (1) leaching of soluble compounds from litter into the soil matrix by water, (2) fragmentation of litter into smaller sizes by soil animals and (3) catabolism or chemical alteration by soil organisms [4, 5]. Because of its complexity, many factors play role on this mechanism. Litter decomposition rate may significantly vary with litter type and environmental conditions [6, 7].

In litter decomposition studies, scientists usually focused on soil surface because it was thought that litters normally accumulate on soil surface. But in some areas especially in agricultural fields, plant litter may mix into soil due to plowing. So, decomposition rate may differ based on soil depth. Environmental conditions such as temperature, humidity, amount of nutrients and microbial activity vary in different soil depths and this may change decomposition rate.

The objective of the study was to determine the effect of litter placement to decomposition rate of *Juglans regia* L. leaf litter. It was hypothesized that decomposition rate may be increase as the soil depth increase, especially in warm and arid environments. Because, the temperature in soil within limits may be lower than that on soil surface in warm habitats and it is reverse in cold habitats. Humidity may increase in soil within limits especially in arid environments. Water on soil surface may be frozen due to low temperatures. *J. regia* is one of the most common and economically important trees in the study area. Its fruit is used as food for organisms especially for humans.

Although, there are several studies on effects of environmental factors on decomposition rate, a few studies were conducted on effect of litter placement [8, 9]. Determining the differences in decomposition rate may provide useful information for future agricultural and ecological treatments and studies. In some areas fast decomposition rate is wanted, because litter decay is very slow. In other areas, slow decomposition is wanted because of soil protection from cold climate.

MATERIALS AND METHODS

The field study was carried out in Suluova, Amasya in Middle Blacksea Region of Turkey. Senescent leaves of *J. regia* were used as study material. Senescent *J. regia* leaf samples were collected from six *J. regia* trees in the same orchard. Litter bag technique was applied in order to examine leaf litter decomposition process of *J. regia* [10]. Collected leaf samples were air dried for a week and then dried in drying oven at 75 °C until constant weight was reached. The litter bags, made from fiberglass net with 2 mm mesh, were 20×20 cm in size [1]. Each litter bag enclosed 2 g of *J. regia* leaf litter. In order to examine the effect of litter placement to decomposition rate, three placement depths (0, 5 and 10 cm) were selected and litter bags were fastened to these soil depths. Four months period (March, April, May and June) of decomposition was examined. Twelve treatments (3 placement depth x 4 months) were replicated 5 times. All the litter bags were fastened by iron nails to soil of a different open site in December. The litter bags were fastened to different area because of lack of former *J. regia* litter in this site. The decomposed litter bags were collected in March (three months later), April, May and June. The litter bags were air-dried in the laboratory. Then, foreign materials on the decomposed litters were removed by washing with distilled water. Litter samples were dried at 75 °C in a drying oven until constant weight was reached. Remaining dry weights of decomposing leaf litter were measured.

Decomposition rate parameters were calculated as below [11].

$$\textbf{Mass Loss}\ (\%) = \frac{\textbf{Initial mass} - \textbf{Mass in t time}}{\textbf{Initial mass}} \times 100 \qquad (1)$$

$$\textbf{Daily decomposition rate} = \textbf{Mass loss}\ (\%)/\textbf{Incubation time}\ (\textbf{in days}) \qquad (2)$$

$$\frac{W}{W0}(\%) = e^{-kt} \qquad (3)$$

W is the weight of litter at an elapsed t time, W_0 is the initial mass, t is the elapsed time (year) and k constant is the decomposition rate ($year^{-1}$).

RESULTS AND DISCUSSION

Remaining dry weights, mass loss (%), daily decomposition rate and k values were given with soil depth and months in Table 1. Results showed that except daily decomposition rate and *k* value in May all decomposition parameters significantly varied with soil depth. Decay rate generally tended to increase according as soil depth increase in all months.

Table-1: Decomposition parameters with soil depths and months (The differences in decomposition parameters among months were indicated by capital letters and among placement depths were indicated by small letters).

		March	**April**
Remaining dry weight (gr)	0cm	1.41 ± 0.01Aa	1.26 ± 0.02Ba
	5cm	0.73 ± 0.05Ab	0.54 ± 0.06Bb
	10cm	0.90 ± 0.13Ac	0.39 ± 0.06Bc
Mass loss (%)	0cm	29.57 ± 0.26Aa	36.95 ± 0.86Ba
	5cm	63.57 ± 2.68Ab	72.89 ± 3.07Bb
	10cm	55.05 ± 6.52Ac	80.38 ± 2.85Bc
Daily decomposition rate	0cm	0.33 ± 0.01Aa	0.35 ± 0.05Aa
	5cm	0.71 ± 0.03Ab	0.85 ± 0.26Ab
	10cm	0.61 ± 0.07ABc	1.85 ± 0.30Cc
k value	0cm	1.42 ± 0.02Aa	1.35 ± 0.19Aa
	5cm	4.11 ± 0.29Ab	3.63 ± 1.30Aa
	10cm	3.28 ± 0.62Ac	10.08 ± 2.72Bb
		May	**June**
Remaining dry weight (gr)	0cm	1.12 ± 0.06Ca	0.86 ± 0.02Da
	5cm	0.37 ± 0.06Cb	0.28 ± 0.01Db
	10cm	0.29 ± 0.01BCc	0.26 ± 0.01Cb
Mass loss (%)	0cm	43.99 ± 2.83Ca	56.81 ± 0.89Da
	5cm	81.46 ± 2.95Cb	86.03 ± 0.49Cb
	10cm	85.74 ± 0.38Bc	86.79 ± 0.39Bb
Daily decomposition rate	0cm	0.37 ± 0.15Aa	0.76 ± 0.14Ba
	5cm	1.01 ± 0.60Aa	0.76 ± 0.47Aa
	10cm	0.86 ± 0.41Aa	0.24 ± 0.14Bb
k value	0cm	1.45 ± 0.62Aa	3.15 ± 0.67Bab
	5cm	4.69 ± 3.00Aa	3.32 ± 2.21Aa
	10cm	3.77 ± 1.93Aa	0.93 ± 0.54Ab

Similarly, increased decomposition rate in buried litter were reported by several studies [12, 13, 8]. In contrast, Gill and Burke [14] told that by some of the studies it is found that decomposition rates decreased with depth in the soil profile [15, 16]. van Dam et al. [16] determined that decomposition rate may be six times greater at the soil surface than at 1 m in a humid forest [14]. Previous studies which reported decrease in decomposition rate due to soil depth were carried out at deeper soil profiles such as 1 m compared with current study.

In March which covers three-month period, the maximum mass loss (%), daily decomposition rate and k value were determined at 5 cm depth and it was followed by 10 and 0 cm depths. The maximum decomposition rate was found at 10 cm depth and more than half of the mass was lost in April. The fastest decomposition was at 5 cm depth and the slowest decomposition was at 0 cm depth in May. In June, the maximum decomposition was determined at 5 cm depth and the minimum decomposition was found at 10 cm depth.

At 0 and 5 cm depths, mass losses were the maximum in March while the maximum mass loss was in April in 10 cm depth. The daily decomposition was the fastest in June and slowest in March in 0 cm depth. In 5 cm, the maximum and minimum daily decomposition rate was in May and March, respectively. The maximum and minimum daily decomposition was determined in May and June, respectively. The highest decomposition rate (*k* value) was found in March at 0, 5 and 10 cm depths. The lowest decomposition rate was determined at May in 0 cm depth while it was determined in June at 5 and 10 cm depths.

Considering all results completely, except first three-month period this study showed that the maximum decomposition occurred at 10 cm depth and it was followed by 5 and 0 cm depths. The decomposition rate also varied with months. This variation may be caused by different stages of decomposition and differences in climatic conditions. It was reported that precipitation, temperature and soil texture are the major predictive factors of decomposition rate. The relative importance of these determinants depends on field type and characteristics. Type and population density of decomposer organisms also vary with soil depth. Decomposition rate and types of bacteria and fungi are different. Densities of bacteria and fungi are based on several factors such as amount of organic matter, concentrations of some elements in soil and Ph. So, variation in decomposition rate based on soil depth and months may be strongly caused by differences in these factors and decomposer flora and fauna. It was reported that since the temperature and moisture availability decrease through a soil profile, decomposition rates would be lowest in the lower soil profile [14, 17]. This may be valid for deeper soil profiles, but in the current study effect of litter placement was examined between 0-10 cm depths. So, degree of temperature and moisture in soil may be more useful for decomposition than that on soil surface. Thus, when compared with soil surface, increase in decomposition rate in soil profile (especially at 5 cm depth) is resulted from suitable temperature and humidity. Additionally, organisms into the soil such as worms also considered as a factor that increase decomposition rate in lower soil depths.

CONCLUSION

This study showed that decrease in decomposition rate based on soil depth may be valid for deeper soil profiles such as 1 m. In upper layers of soil, decomposition rate may increase in buried litter depending on land characteristics such as climate and soil texture.

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REFERENCE

1. Karavin N, Ural Z; Impact and extent of traffic-based pollution on N and P use proficiency and litter decomposition in *Malus domestica* Borkh. Water, Air & Soil Pollution, 2016; 227(6):1-10.
2. Berg B, McClaugherty C; Plant Litter. Berlin Heidelberg: Springer-Verlag; 2008.
3. Karavin N, Cımık A, Ural Z, Erdem E. Dynamics of litter decomposition: Effect of antimicrobial features on leaf decomposition. International Journal of Pure and Applied Biosciences, 2016; 4(1):24-27.
4. Chapin FS, Matson PA, Mooney HA; Principles of terrestrial ecosystem ecology. Springer-Verlag, New York, 2002.
5. Kutsch WL, Bahn M, Heinemeyer A; Soil carbon dynamics: an integrated methodology. Cambridge University Press, Cambridge, 2009.
6. Zhang D, Hui D, Luo Y, Zhou G; Rates of litter decomposition in terrestrial ecosystems: global patterns and controlling factors. Journal of Plant Ecology, 2008; 1(2):85-93.
7. Gaxiola A, Armesto JJ; Understanding litter decomposition in semiarid ecosystems: linking leaf traits. Frontiers in Plant Science, 2015; 6:104
8. Holland EA, Coleman DC; Litter placement effects on microbial and organic matter dynamics in an agroecosystem. Ecology, (1987); 68(2):425-433.
9. Powers JS, Montgomery RA, Adair EC, Brearley FQ, DeWalt SJ, Castanho CT, ... González-Iturbe JA; Decomposition in tropical forests: a pan-tropical study of the effects of litter type, litter placement and mesofaunal exclusion across a precipitation gradient. Journal of Ecology, 2009; 97(4):801-811.

10. Weerakkody J, Parkinson D; Leaf litter decomposition in an upper montane rainforest in Sri Lanka. Pedobiologia, 2006; 50(5):387-395.
11. Olson JS. Energy storage and the balance of producers and decomposers in ecological systems. Ecology, 1963; 14:322-331.
12. Blevins RL, Smith MS, Thomas GW; Changes in soil properties under no-tillage. In No-tillage agriculture: principles and practices. Phillips RE, Phillips SH editors Reinhold, New York, 1984: 190-230.
13. House GJ, Stinner BR, Crossley DA, Jr, Odum EP, Langdale GW; Nitrogen cycling in conven-tional and no-tillage agroecosystems in the southern Pied-mont. Journal of Soil and Water Conservation, 1984; 39:194-200.
14. Gill RA, Burke IC; Influence of soil depth on the decomposition of *Bouteloua gracilis* roots in the shortgrass steppe. Plant and Soil, 2002; 241(2):233-242.
15. Trumbore SE, Davidson EA, de Camargo PB, Nepstad DC, Martinelli LA; Belowground cycling of carbon in forests and pastures of Eastern Amazonia. Global Biogeochemistry Cycles, 1995; 9:515-528.
16. van Dam D, Veldkamp E, van Breemen N; Soil organic carbon dynamics: variability with depth in forested and deforested soils under pasture in Costa Rica. Biogeochemistry, 1997; 39:343-375.
17. Weaver JE, Houghen VH, Weldon MD; Relation of root distribution to organic matter in prairie soil. Botanical Gazette, 1935; 96:389-420.