Thai J. For. 9 : 212-218 (1990) วารสารวนศาสตร์ 9 : 212-218 (2533)

ON THE RATE OF WOOD LITTER DECOMPOSITION IN DRY EVERGREEN FOREST IN THE NORTHEAST OF THAILAND

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บทคัดย่อ

การศึกษาเรื่องนี้ได้ดำเนินการศึกษาที่บริเวณป่าดิบแล้งใกล้กับสถานีฝึกนักศึกษาคณะเกษตรศาสตร์ มหาวิทยาลัยขอนแก่น เขื่อนจุฬาภรณ์ จังหวัดชัยภูมิ ตัวอย่างซากพืชที่ใช้ทำการศึกษา เป็นตัวอย่างสด ที่เก็บจากไม้ตัวอย่าง ที่ขึ้นอยู่ในป่าดิบแล้งบริเวณนั้นเอง จำนวน 6 ต้น คือไม้ลิ้นกระบือ *(Excoecaria bicolor)* 3 ต้น ตะแบกเปลือกบาง *(Lagerstroemia calyculata)* ลำไยป่า *(Paranephelium longifolium)* และหลังดำ *(Diospyros castanea)* อย่างละต้น บางต้นก็เก็บตัวอย่างที่เป็นกิ่ง และบางต้นก็เก็บจากลำต้น ตัวอย่างเหล่านี้จะถูกนำไปวางไว้ในพื้นป่าหลังจากทราบขนาดต่าง ๆ รวมทั้งน้ำหนักแล้ว และได้ทำการชั่งหาน้ำหนักของตัวอย่างเหล่านี้ทั้งหมดเฉลี่ยปีละหนึ่งครั้ง รวม 4 ปี ระหว่างปี 2524-2528 ผลการศึกษาปรากฏว่า ตัวอย่างของซากพืชที่สลายตัวมากที่สุดถึง 96% สำหรับไม้หลังดำ 96, 96 และ 93% สำหรับตัวอย่างจากไม้ลิ้นกระบือ รองลงมาคือ 83% สำหรับไม้ตะแบกเปลือกบาง ส่วนไม้ลำไยป่าระหว่างที่ทำการศึกษานี้สลายตัวน้อยที่สุด คือ 39% เท่านั้น จากการศึกษานี้เห็นได้ว่า ขนาดและความหนาแน่นของไม้ตัวอย่างไม่ได้มีส่วนเกี่ยวข้องกับอัตราการสลายตัวแต่อย่างใด การเจาะทำลายของแมลงบางชนิดและปลวกดูเหมือนว่าจะมีส่วนสำคัญอย่างยิ่งต่อการสลายตัวของซากพืช และการสลายตัวของซากพืชยังขึ้นอยู่กับระยะเวลาด้วย จะเห็นว่าการสลายตัวของซากพืชในปีที่ 3 และ 4 จะมากกว่าปีที่ 1 และ 2 ของไม้ทุกชนิดที่ทำการศึกษาครั้งนี้

ABSTRACT

The study on the wood litter decomposition was carried out in a dry evergreen forest at Khon Kaen University Farm at Nam Phrom Dam. Samples were collected from six individual trees, and were kept on the forest floor. The weight of samples remaining on the floor were measured nearly one year interval for four years. Four samples among six lost more than 93% of their weight and the other one lost 83%, while the remaining one lost only 39% during four years. The rate of decomposition and factors connected to the rate were discussed.

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INTRODUCTION

It is known that large amount of wood litter is accumulated on forest floor of mature forests in forms of dead big branches and stems. In the forest studied, the amount of big litter accumulated, i.e. big branches and stems litter was 10.4 t/ha, while that of small litter such as leaves and small branches was 6.7 t/ha (T.Tsutsumi *et.al.*, 1983). It is reported that the amount of coarse woody debris ranged from 6 to 269 t/ha for intact temperate forests (Harmon, M.E.,et al.1986). Though there is wide range of variation in the amount, it is evident that a lot of wood litter is accumulated in intact forest. It is also reported that the amount of dead wood litter is in the range of 10-70 t/ha in various forests (Yoneda, 1986). Those reports indicate that the accumulation of wood litter usually range in the order of several tens of tons/ha, in intact mature forest.

However, the studies on the wood litter production and their decomposition in forests are very few, particulally in tropical forest, because the measurement of those items is quite time-consuming and laborious as well. However, studies on wood litter are required, because of its large amount of accumulation as well as its importance on cabon cycle in forest. This is a report dealing with a preliminary experiment on the rate of decomposition of wood litter in forest at Northeast Thailand.

We thank Dr. Pongsak Sahunalu and Dr. Pricha Dhanmanonda (Kasesart University) for their helpful support on our field study.

MATERIALS AND METHODS

The study was carried out in Khon Kaen University Farm at Nam Phrom Dam (Chulabhorn Dam), *Amphoe* Khon San, *Changwat* Chaiyaphum, 140 km west of Khon Kaen, about 800 m in elevation.

The study plot was set up in a natural dry evergreen forest in this Farm and the studies on biomass, mineralmass and productivity have been carried out. The details of the studied forest had been described in the previous papers (Tsutsumi, T. *et al.*1983, Prachaiyo, B. & Tsutsumi, T. 1989).

Annual mean temperature is 23.2 C (lowest monthly mean is 19 C in Dec., and in rainy season, they are 24-26 C), and the warmth index is 217 C mo.. Annual precipitation is 1532 mm, and it concentrate in rainy season, from March to October. Rainfall in dry season, from November to February is few, 80 mm., as shown in Table 1.

Six sample trees were selected, and 20 cm length of samples were collected from branches of each five sample trees, and their diameter was around 5-7 cm. For sample tree No.7, samples were collected from stem, and their diameter was 9-12 cm, though the length was 20 cm, same as above five. The number of samples for each Sample tree are 14-19, as shown in Table 2.

After the measurement of weight of each every samples, they were kept on the forest floor of the forest with each sample number. In this study, fresh branches and stems, which were collected from trees just after cut down, were used for sample. The study started on Oct.1980, and measured the weight of each sample nearly one year interval, i.e., Oct.1981, Oct.1982, Jan.1984 and Dec.1984, respectively. The measurement of moisture content of samples was carried out for each year.

Table 1. Temperature (°C) and precipitation (mm) at Nam Phrom Dam

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Temp.	21.2	21.9	25.8	25.6	25.1	24.6	24.7	23.9	23.5	22.4	20.5	18.9	23.2
Prec.	13	34	130	191	216	118	114	195	340	149	28	4	1532

(Kyuma, K. & Pairintra, C. 1983, Ref. No. 1)

Table 2. Characteristics of Samples (length of sample ; 20 cm)

Sample No.	Species	No. of Sample	Dia. cm	Dry wt. g	Density g/cc	
2	Excoecaria bicolor	17	5.5±0.6	244± 61	0.51±0.04	B
7	Excoecaria bicolor	14	10.6±0.7	997±145	0.57±0.03	S
10	Excoecaria bicolor	19	6.3±0.4	253± 25	0.41±0.02	B
12	Lagerstroemia duperreana	17	6.1± 0.5	283± 48	0.49±0.03	B
15	Paranephelium longifolium	18	5.2±0.4	197± 26	0.47±0.04	B
18	Diospyros costanea	17	5.4±0.4	224± 31	0.48±0.03	B

B ; branch, S ; stem,

Table 3. Change of weight with time (dry weight)

Sample No.		Initial	After 1 yr.	After 2 yr.	After 3 yr.	After 4 yr.
2	wt.g	244±61	173±33	125±32	55±35	15±14
	remain. %	100	72± 7	52± 6	22±12	7± 7
7	wt. g	997±145	781±126	500±80	264±124	46±60
	remain. %	100	78± 3	50± 4	26±11	4± 6
10	wt. g	253±25	161±24	116±28	16±16	6±10
	remain. %	100	62± 7	46± 9	7± 7	2± 4
12	wt. g	283±48	189±37	150±23	74±35	48±40
	remain. %	100	66± 5	53± 5	26±12	17±14
15	wt. g	197±26	181±27	141±17	121±23	115±50
	remain. %	100	92± 4	72± 5	61± 8	61±19
18	wt. g	224±31	133±21	85±27	15±14	5± 6
	remain. %	100	60± 5	38±10	7± 7	2± 3

RESULTS AND DISCUSSION

Weight Loss

The progress of decomposition in term of weight decrease with time is shown in Table 3. The weight decrease with time as percentage for initial weight is presented in Figure 1, using same result as Table 3.

As shown in Table 3 and Figure 1, the rates of decomposition were rather high except of sample No. 15. During four years, almost of all materials were lost for Sample 10, 18, 7 and 2. The remainings were 2, 2, 4 and 7% for initial material, respectively. While, the rate for Sample 12 was little lower than the above four samples, i.e.,the remaining after four years was 17%. However, the rate of decomposition for Sample 12 for first, second and third year did not differ significantly with Sample 2 and 7. The difference in the rate became clear on the fourth year. The rate was definitely low at fourth year. While, the rate of decomposition for Sample 15 was exceptionaly low, and 61% of material was still remained after four years. The rate was particularly low on the fourth year, and there was no progress of decomposition on the fourth year.

Though there was some difference in the rate of decomposition between Sample 2, 7, 10 and 18, it is hard to conclude that there is the significant difference in the rate of decomposition between those four Samples, because there was some deviation in the rate within same Sample tree. Moreover, Sample 2, 7 and 10 are the same in species and size. Those four Samples are easily decomposed, and are grouped into fast decomposed. Sample 12 can be classified into moderately fast decomposed, however, there was no significant

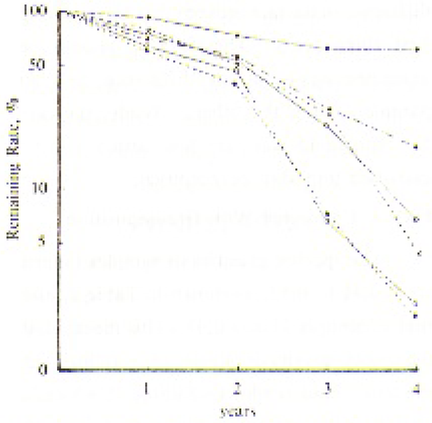

Figure 1. Change of weight with time for each Sample.

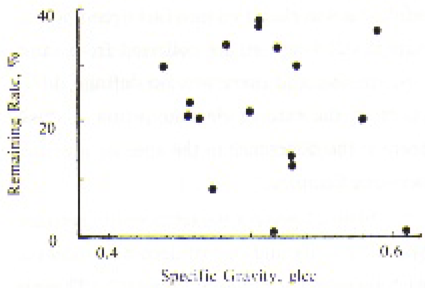

Figure 2. Relationship between specific gravity (g/cc for initial material) and rate of decomposition (after three years, as remaining rate) for Sample No. 2.

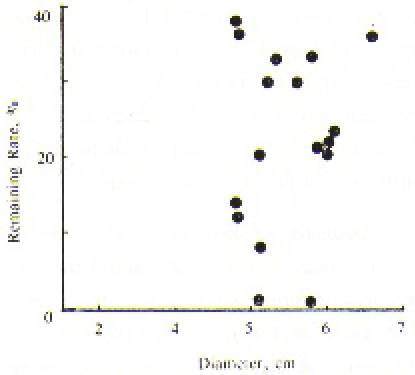

Figure 3. Relationship between diameter of sample and rate of decomposition (after three years, as remaining rate) for Sample No. 2.

difference in the rate between first group during first three years. Therefore, it should be examined again on the difference between Sample 12 and the others. While, the rate for Sample 15 was very low, and it can be classified into slow decomposed.

Factors Connected With Decomposition

The specific gravities of samples ranged from 0.41 to 0.57, as shown in Table 2, and that of Sample 15 was 0.47. This means that the specific gravity of Sample 15 is not high but moderate, and similar to Sample 18 which is classified into fast decomposed. Sample 7 shows the highest specific gravity, i.e. 0.57, while this was classified into fast decomposed. Samples 2, 7 and 10 are collected from same tree species, and there was no definite difference in the rate of decomposition, though there is the difference in the specific gravities between Samples.

Figure 2 present the relationship between specific gravity and rate of decomposition for each seventeen samples of Sample 2. There is no clear relationship between above two. Those results indicate that the rate of decomposition does not affected by the specific gravity of wood litter, though there are some reports showing rather close relationship between above two (Yoneda,*et.al.* 1977, Yoneda,1986). This would be due to the less difference in density among Samples.

Diameter of material is also one of the important factor which control the rate of decomposition (Rayner & Boddy, 1988, Harmon *et.al.*,1986). Though there is some difference in diameter of materials among Samples of this experiment, however, there was no clear relationship between diameter and the rate of decomposition, as shown in Table 2 and 3. Diameter of Sample 7 was bigger than the other, but the rate of decomposition was fast. Figure 3 shows the relationship between diameter and the rate of decomposition for each sample of Sample 2. The rate of decomposition is not related with diameter. This implies that the difference of diameter in the study is not big enough to change the rate of decomposition. Therefore, it is likely that the size of the Sample was not the reason why there is difference in the rate of decomposition.

There was no difference in the environmental condition among samples, because all Samples were kept on the floor of the same forest. The difference of the rate of decomposition would be attributable to the difference of wood quality. Sample 15, *Paranephelium longifolium*, is assumed to be rather resistant to decomposition. Most of samples, except of Sample 15, were attacked by some borer and termite from the beginning of decomposition. This implies that palatability of those borer and termite for wood litter differ depending on species characteristics, and this difference must be one of the effective factor of decomposition. In addition, it should be kept in mind that the material used in this study was fresh, just after cut, and this may have some connection to the rate of decomposition.

Rate of Decomposition

As shown in Figure 1, the rate of decomposition changed with time. In case of Sample of fast decomposed, the rate for third and fourth year were higher than that for first and second year. The rate became higher with the progress of decomposition, particularly for Samples 2 and 7. The most commonly used model for decomposition was the single exponential model, that is, $Yt = Yo \cdot e^{-kt}$; Yo is initial weight, Yt is weight at time t, t is time and k is rate constant of decomposition (Harmon,*et al.*,1986). However, it is well known that "k" is not constant throughout decomposition, but change with time. Usually, the rate of decomposition of leaf litter is faster at the beginning, and decrease gradually with time, because materials change to highly resistant to decomposition with time. In case of figure 1, "k" increased with time. This would be due to the change of quality of wood litter such as moisture content, surface area, hardness, composition and so on. It is likely that wood litter changed to be favourable for decomposition with time (Yoneda, 1986). This indicate that is sometimes lead to overestimation of the necessary time for decomposition, if it is estimated based on the rate of decay at the beginning.

The rate constant of decomposition for temperate forest ranged from 0.005 to 0.5, while many of them were in the range of 0.01 and 0.1. This means that half time are in the range of 10 and 60 years (Harmon, *et al.*1986). As shown in Figure 1, all Samples except of Sample 15, lost their half weight after about 2 years. Rayner *et al.*(1988) also summarized the rate of decomposition of wood litter, and annual rate of weight loss was around 10-30% based on knowledge of input and standing-crop data. The loss rate of wood litter in Malaysia forest was 19 and 39% during 400 days (Yoneda *et al.* 1977). The rate in those reports are in nearly same range of the present study. It is likely that the rate of wood litter decomposition is rather fast in tropical forest under cooperation of insect and termite. However, the rate change depending on various conditions such as size, density, mineral content, environmental condition and so on. More intensive study is necessary to be able to compare the rate of decomposition of wood litter.

CONCLUSIONS

In the present study, wood litter had decomposed almost completely during four years for four among six Samples. The weight loss during four years were 98% for *Diospyros castanea*, 98, 96 and 93% for *Excoecaria bicolor*, 83% for *Lagerstroemia duperreana* and 39% for *Paranephelium longifolium*, respectively. Size and density of materials had no connection with the rate of decomposition, in this study. The contribution of borer and termite for decomposition was so remarkable that paratability of those animals for wood litter would be effective for decomposition. The rate of decomposition change with time, and the rate was higher for third and fourth year than first and second year, for the samples decomposed rapidly.

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