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Original Research Article

Litterfall pattern in a fresh-water swamp forest in India

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A B S T R A C T

Keywords

Fresh-water swamp; Litterfall.

Litterfall of three tree species *Bischoffia javanica*, *Diospyros peregrina* and *Pterospermum acerifolium* in Golatappar swamp forest was estimated in the present study. The tree species were found to be of a summer leaf shedding type. The tree species were found to be of a summer leaf shedding type. The total mean leaf litterfall was 4.2 t/ha/yr, whereas the total litterfall was 6.8 t/hr/yr. Maximum litterfall 2441.4 kg/ha occurred in the month of May.

Introduction

Litter on forest floor plays a major role in the structure and function of a terrestrial ecosystem in the tropics (Bray and Gorham, 1964). Studies on litter production indicate that it serves as a nutrients reservoir and as substrates for detritus food web. It alters the micro-environment and may affect the structure and dynamics of plant communities. Clements (1916) considered litter accumulation as a part of successional "reaction", i.e., environmental changes produced by the action of colonizing organisms. The litter on the forest floor acts as input-output system of nutrient and the rates at which forest litter falls and subsequently, decomposes contribute to the regulation of nutrient cycling and primary productivity, and to the maintenance of soil fertility in forest ecosystems (Olson, 1963; Singh *et* al., 1999; Fioretto *et* al., 2003; Onyekwelu *et* al., 2006; Pandey *et* al., 2007). Therefore, it is critical to understand the amount and pattern of litterfall in these forest ecosystems.

The decomposition of litter is primarily influenced by the environmental conditions in which decay takes place, the chemical quality of leaf litter, and the nature and abundance of decomposing organisms present (Swift *et* al., 1979; Polyakova and Billor, 2007). Despite many studies carried out on litter decomposition, most of them have considered the decomposition of litter of a given species in isolation from other

species in one forest stand in subtropical forest ecosystems (Rai and Proctor, 1986; Adams and Angradi, 1996; Sundarapandian and Swamy, 1999). Litter decay of each species present has the potential to be affected by the presence of litters from coexisting plant species.

In India estimation of annual leaf litter in deciduous and evergreen forests have been reported by Puri (1953) Singh (1968), Subba Rao *et* al., (1972), Pandey and Singh (1981), Garg and Vyas (1971), Singh and Ramkrishnan (1982), Raizada and Srivastava (1986), Rai and Procter (1986).

Litter production in swamps has reported from various other countries (Carter *et* al., 1973; Conner and Day, 1976; Mullholland, 1979; Brinson *et* al., 1980; Gomez and Day, 1982), but such studies from India are rare (Ghildiyal and Srivastava, 1992). The present paper deals with the annual litter production pattern of the three plant species at Golatappar swamp forest, Dehradun (India).

Study Site and Climate

The present study was conducted in Golatappar swamp near Khiri village, the study area lies at 30^{o} 06' North Latitude and 78^{o}19' East Longitude at an elevation of 370 meters 35 km to the east of Dehradun. The study site is a 7b forest block of Barkot range of the Eastern Forest Division of Dehradun. The forest has a dominance of *Bischoffia javanica*, *Diospyros peregrina* and *Pterospermum acerifolium* species. The study area is biotically disturbed due to villagers coming for their fuel and fodder needs.

The climate of the region is typical monsoonic with three well-defined seasons. The mean monthly maximum and minimum temperatures during the study period were recorded as 36.6^{o}C and 6.3^{o}C respectively. November to February is a relatively dry period. Annual rainfall in the year 2011 was recorded 1956.70 mm. The soil of the area is silty loam to sandy loam. The Ph of the soil ranged in between 6.7 to 7.5.

Materials and Methods

Studies were carried out in a fenced plot of 200m x 200m from January 2011 to December 2011 using the ground sampling method (Newbold, 1967). Litter was collected at monthly intervals from the ground by making one square meter permanent quadrates. The quadrates were made permanent by enclosing the area using nylon thread to last throughout the study period. The litter was collected at the end of every month and then dried to constant weigh at 80^{o}C. Each component of the oven dried litter was weighed for each species.

Results and Discussion

The total annual litterfall recorded for the three species during the study period was 6864 kg/ha (Table 1). Least litterfall occurred in the month of November (99.6 kg/ha) and maximum in May (2441.4 kg/ha). Maximum leaf litter, twig litter and bark litter all recorded in the month of May were 1497.6 kg/ha, 669.6 kg/ha and 274.2 kg/ha respectively. Minimum leaf litter was 46.4 kg/ha in November; whereas minimum bark litter (16.4 kg/ha) occurred in the month of September. Of the total litter, leaf litter contributed 64.8% (4236 kg/ha/yr), twig litter contributed 24.2% (1806 kg/ha/yr) and the bark litter contributed only 11.0% (822 kg/ha/yr).

Table.1 Total monthly litter production (kg/ha) in Golatappar swamp forest

Month	Leaf litter		Twig litter		Bark litter		Total litter
January	145.4	± 5.6	62.6	± 1.2	34.0	± 1.8	242.0
February	264.6	± 11.8	85.4	± 4.6	44.4	± 1.2	394.4
March	336.4	± 23.4	90.0	± 3.6	54.6	± 7.2	481.0
April	64.2	± 41.8	232.4	± 4.8	106.6	± 4.8	403.2
May	1497.6	± 52.4	669.6	± 8.6	274.2	± 9.9	2441.4
June	840.0	± 56.4	300.6	± 27.6	100.4	± 4.6	1241.0
July	428.2	± 37.0	137.4	± 4.6	74.4	± 9.2	640.0
August	209.4	± 24.6	64.2	± 3.6	44.6	± 4.6	318.2
September	170.2	± 13.4	52.6	± 7.8	16.4	± 2.2	239.2
October	76.0	± 4.2	40.2	± 5.8	25.6	± 2.6	141.8
November	46.4	± 7.2	28.4	± 2.6	24.8	± 4.2	99.6
December	157.6	± 4.6	42.6	± 2.2	22.0	± 3.3	222.2
Average	353.0		150.5		68.5		572.0
Total	4236.0		1806.0		822.0		6864.0

Table.2 Annual Litter production in some of the important swamps of the world.

Swamp/Community	Litter production (t/ha/yr)	Authority
A. Flowing water flood plain forest:		
-Cypress swamp and Eusteries, South Florida	7.56	Carter *et* al., (1973)
-Louisiana swamp:		
i) Bottom land hardwood	5.7	Conner and Day (1976)
ii) Cypress tupelo stand	6.2	Conner and Day (1976)
-Small stream swamp, North California	6.04	Mulholland (1979)
-Riverine forest, Central Amazonia	6.4	Franken *et* al., (1979)
-Alluvial swamp, North Carolina	6.42	Brinson *et* al., (1980)
B. Still water swamp:		
-Cypress forest of Okefenoke swamp, Georgia	3.28	Schlesinger (1978)
-Cypress dome of North Florida	4.75	Odum and Ewel (1979)
-Dismal swamp, Virginia		
i) Cypress community	5.28	Gomez and Day (1982)
ii) Maple-gun community	5.36	Gomez and Day (1982)
iii) Cedar community	5.06	Gomez and Day (1982)
iv) Mixed comminuty	4.55	Gomez and Day (1982)
-Tropical fresh-water swamp, Rhishikesh	8.1	Ghildiyal and Srivastava (1986)
-Tropical fresh-water swamp, Golatappar	6.8	Present study

The total annual litter production estimated for three species in Golatappar swamp forest was 6.8 t/ha/yr. Bray and Gorham (1964), reported 6.4 t/ha/yr litterfall for warm temperate region lying between 30 to 40 in Northern latitudes. The present investigation, therefore, is in agreement with the finding of Bray and Gorham (1964). In the present study, leaf litter contributed 64.8% of the total litter. This is also supported by Bray and Gorham (1964) who showed that leaf litter contributed roughly 70% of the total litter. There was only one distinct peak of litterfall in the month of May. A second indistinct peak was observed in the month of December (Table 1)Such observation have also been made by Laudelot and Mayar (1954) in a young secondary forest and Gomez and Day (1982) in Dismal swamp and Ghildiyal and Srivastava (1992) in Manu swamp. The increases in leaf fall due to drought conditions have also been reported by Pool (1913) and Raizada and Srivastava (1986). Pattern of litterfall in this study was comparable with other results in subtropical forest ecosystems (Zhang *et* al., 1993; Sundarapandian and Swamy, 1999; Pandey *et* al., 2007).

Litter production in some of the important swamps of the world is shown in Table 2. The present findings resemble to that of Conner and Day (1976), Odum and Ewel (1979) and Gomez and Day (1982). However, in various other swamps litter production of 5 t $ha^{-1}yr^{-1}$ been reported. Ghildiyal and Srivastava (1992) have also been reported 8.1 t $ha^{-1}yr^{-1}$ annual litter production in Manu swamp located in Rishikesh. These values are greater than those found in this study. This is probably due to the history of litter removal by villagers in the area.

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