GROWTH, LITTERFALL AND LITTER DECOMPOSITION OF *CASUARINA EQUISETIFOLIA* IN A SEMIARID ZONE

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UMA M, SARAVANAN TS & RAJENDRAN K. 2014. Growth, litterfall and litter decomposition of *Casuarina equisetifolia* in a semiarid zone. Tree growth, litterfall, litter decomposition, nutrient return through litter and litter decomposing microorganisms were quantified in 1-, 2- and 3-year-old high density *Casuarina equisetifolia* plantation (10,000 trees ha^{-1}) in a semiarid zone of Tamil Nadu, India. The growth of trees recorded 2.6 cm diameter at breast height (dbh) with total height of 3.8 m. The basal diameter and volume of trees were 12.4 cm and 0.0017 m^3 respectively 12 months after planting. Three-year-old trees showed 6.5 cm dbh with total height of 13.3 m. Their basal diameter and volume were 26.4 cm and 0.0372 m^3 respectively. Litterfall was recorded at a rate of 0.64, 4.69 and 5.19 t ha^{-1} $year^{-1}$ in 1-, 2- and 3-year-old plantations. Nutrient turnover through litter was in the order of Ca > N > K > Mg >Na >P >Fe > Zn > Cu > Cr in all ages. The constant value of annual decomposition was 1.83. Decomposition rate was higher during the rainy season. Seven fungal species were isolated and identified in the litter of 3-year-old plantation.

Keywords: Decomposing microorganisms, plantation forestry, nutrient cycling, southern India

UMA M, SARAVANAN TS & RAJENDRAN K. 2014. Pertumbuhan pokok, luruhan sarap dan penguraian sarap *Casuarina equisetifolia* di zon separuh kontang. Pertumbuhan pokok, luruhan sarap, penguraian sarap, pengembalian nutrien daripada sarap, mikroorganisma pengurai sarap ditentukan di ladang *Casuarina equisetifolia* kepadatan tinggi (10,000 pokok ha^{-1}) di zon separuh kontang di Tamil Nadu, India. Ladang ini berusia 1 tahun, 2 tahun dan 3 tahun. Pertumbuhan pokok merekodkan diameter pada aras dada (dbh) sebanyak 2.6 cm dan ketinggian sebanyak 3.8 m. Diameter pangkal pokok ialah 12.4 cm dan isi padu pokok ialah 0.0017 m^3 selepas 12 bulan. Pokok berusia 3 tahun menunjukkan dbh sebanyak 6.5 cm dan jumlah ketinggian sebanyak 13.3 m. Diameter pangkal pokok berusia 3 tahun ialah 26.4 cm dan isi padu pokok ialah 0.0372 m^3. Luruhan sarap adalah pada kadar 0.64 t ha^{-1} setahun, 4.69 t ha^{-1} setahun dan 5.19 t ha^{-1} setahun masing-masing bagi ladang berusia 1 tahun, 2 tahun dan 3 tahun. Kadar pusingan ganti nutrien melalui sarap adalah mengikut susunan Ca > N > K > Mg >Na >P >Fe > Zn > Cu > Cr bagi kesemua usia pokok. Pemalar penguraian tahunan ialah 1.83. Kadar penguraian lebih tinggi pada musim hujan. Sebanyak tujuh spesies kulat diasingkan dan dikenal pasti daripada sarap berusia 3 tahun.

INTRODUCTION

Litter is the upper layer of organic debris and is composed of freshly fallen materials. Litter from plants, particularly trees, is a major source of organic matter and energy to soil and is important for nutrient cycling in an ecosystem. Nutrients absorbed by roots are stored up in standing trees while a portion gets returned to the soil through dead organic matter. Substantial amounts of nutrients and organic matter produced by plants are returned to the soil through litterfall. Litterfall exerts an immense influence on physical, chemical and biological characteristics of soil as well as growth of trees (Pande et al. 2002). The amount and nature of litterfall have an important bearing on soil formation and the maintenance of its fertility (Panda et al. 2007, Rajendran 2001). Accumulation of layers of litterfall on the topsoil depends on several factors, namely, plant species, climate, type of landuse, decomposer population and their activities (Fernandes et al. 1997). The litter amount and composition are dependent on the structure and species diversity of the plants in a forest (Indriyanto 2009).

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Litter decomposition is the key process controlling the rate at which nutrients of plant biomass are returned and incorporated into forest soil (Ragu 2000, Lodhiyal et al. 2002). Many researchers have attempted to quantify the rate of litterfall and decomposition as an important pathway for the transfer of litter mass and minerals to the soil surface in forest ecosystems (Lodhiyal et al. 2002, Polyakova & Billor 2007). Litter decomposition is influenced by environmental factors and chemical composition of parts such as stem wood, leaves and roots of the species studied and decomposer organisms present in the soil (Vesterdal 1999). Leaf litter contains considerable amounts of nutrients, the release of which is influenced by its decomposition by a variety of microorganisms active under various conditions (Khan & Kapur 1992, Ragu 2000). Studies on nutrient cycling help assess plant and soil nutrient status, which will assist in planning and providing rational application of nutrients. Short rotation tropical plantations that combine intensive management and rapid growth rates are also characterised by high rates of nutrient removal in the harvested biomass. This raises concerns about long-term site quality and sustainable production. The potential nutrient export, especially with whole tree harvesting, may deplete the site of nutrient capital (Jorgensen & Wells 1986, Wang et al. 1991). Altering the rate of nutrient removal is probably important in intensive short rotation silvicultural systems.

In the southern parts of India, most farmers are cultivating *Casuarina* without knowledge of integrated nutrient management. Huge amounts of nutrients are lost through harvesting of *Casuarina* in short rotation (3 years). This practice leads to soil sickness and causes nutrient-deficiency diseases in plants due to loss of soil nutrient through high nutrient uptake (except nitrogen). For efficient and economical use of fertilisers in farm forestry, it is essential to understand nutrient cycling. This is because litter on the forest floor acts as input–output system of nutrient while litter on the soil surface intercepts and stores a certain amount of precipitation, thus reduces run-off and soil erosion (Bahar et al. 2001). Evaluation of litterfall production of *Casuarina* in farm forestry plantation is important for understanding nutrient turnover, C and N fluxes as well as C and N pools. It is also essential to know the litter decomposition rate, nutrient return through litter, decomposing macro- and microorganisms for sustainable nutrient management in farm forestry plantation. The aims of the present investigation were to (1) quantify the growth, litter production and nutrient turnover in 3 consecutive years of planting of *C. equisetifolia* in a semiarid zone and (2) determine the rate of litter decomposition and identify the decomposing microorganisms.

MATERIALS AND METHODS

Site description

The study was conducted in a farm land in a semiarid region of Pudukkottai District, Tamil Nadu, India (10° 23' N latitude 78° 49' E longitude, 179 m above sea level). The temperature ranges from 20 to 35°C and the annual precipitation averages between 650 and 700 mm (Figure1). The soil type is sandy clay (sand 74.6%: silt 10.4%: clay 15%) with pH of 8.1. The organic content of the soil is 1.58%. Nitrogen, phosphorus, potassium, calcium and magnesium contents are 0.47, 0.09, 0.38, 0.60 and 0.26% respectively.

Experimental design and planting

Six-month-old *C. equisetifolia* seedlings were transplanted in 30 cm × 30 cm × 30 cm pits at a spacing of 1 ×1 m in a farmer's field. The experiment was set up in randomised block design. A total of 432 (36 plants in a block with 12 replicates) plants were used. The field was kept free from weeds through periodical hand weeding and hoeing every two months. Watering was done twice a month during summer.

Estimation of soil physico–chemical properties

The soil was sampled using a 45-mm-diameter hand auger. Visible roots and organic residues were removed during sampling. Soil samples were air dried, sieved and stored in cotton bags before analysis. Soil pH was measured using a mixture of soil and deionised water (1:2.5 w/v) (Jackson 1973). Carbon and total nitrogen contents were measured through dry combustion using a carbon-hydrogen-nitrogen-sulphur analyser. Total available phosphorus (P) was measured colorimetrically and total available potassium (K) by flame photometer (Jackson

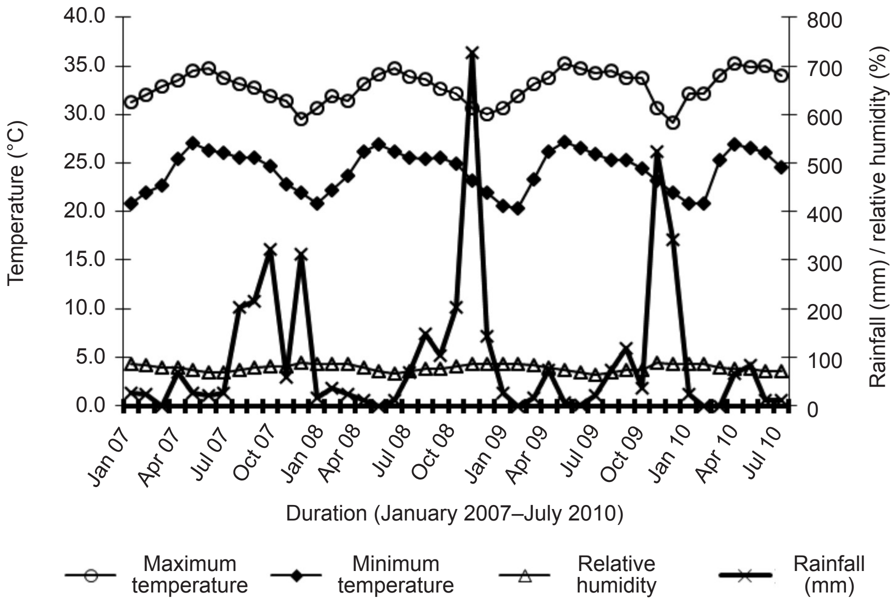

Figure 1 Temperature, rainfall and relative humidity of the study area at Pudukkottai in the east coast of Tamil Nadu (data collected from nearest meteorological station and obtained from Indian Meteorological Department, Chennai, Tamil Nadu)

1973). Micronutrients were estimated using atomic absorption spectrophotometer (Jackson 1973).

Estimation of plant growth

The total height, girth at breast height and basal diameter were measured using a measuring tape. The fresh biomass of scarified plants was weighed using a hanging scale. Basal diameter was used to calculate the volume of trees. The total volume of individual tree was estimated following Ravichandran et al. (2003).

$$\text{Tree volume} = \left(\frac{G}{4}\right)^2 \times H$$

where

G = girth of tree at breast height

H = tree height

Litter fall determination

Litter production was measured for 3 consecutive years continually from January 2007 till 2010. Litter collection was made using wooden traps and 12 traps were randomly placed in the plantation to represent an average of the total area. Each trap was 1 m^2 and 20 cm depth to allow accumulation of falling litter. These traps were designed to allow litter to remain in the containers once trapped and to prevent collected litter from mixing with that outside the trap by the action of wind or small animals. The traps were fixed about 15–20 cm above ground level by pegs at the corners. The litter collected in each trap was removed at monthly intervals, except during the rainy season when weekly collections were made. Collected litter was brought to the laboratory, separated into needle and twig components and oven dried at 80 °C to constant weight.

Litter decomposition

Decomposition of *C. equisetifolia* needle litter was studied using the standard litter-bag technique (Falconer et al. 1933). This study was carried out from June 2007 till May 2008. Freshly collected litter (only needles) weighing 10 g was placed in bags (25 cm × 25 cm) made from nylon net (0.25 mm mesh size) and scattered at the site. In total, there were 36 bags and three bags were removed randomly at monthly intervals. The bags were carefully tapered to remove adhering soil particles. The content was oven dried at 80 °C and weighed. Rate of litter loss was determined based on remaining contents of the bag.

Litter decomposing macro- and microorganisms

Litter was carefully removed and macroscopic organisms were collected by hand using a randomly located 0.25 m^2 sampling frame. Three samples were taken per plot on the day of collection. Decomposing microorganisms were isolated and identified. Samples were temporarily stored in ice prior to isolation of microbes. The decomposing microbes (bacteria and fungi) were isolated by dilution (Waksman 1927) and pour plate (Warcup 1950) techniques using potato dextrose agar medium. Bacterial counts were made 48 hours after inoculation on nutrient agar medium. Fungi were studied after 3 to 7 days of incubation at 28 ± 2 °C.

Decomposition constant (k)

The annual decomposition constant (k) for decay (Olson 1963) of definite amount of litter confined in each bag was calculated as $X_t / X_0 = e^{-kt}$ where X_0 = percentage of initial amount of litter, X_t = percentage amount of litter remaining after time t and k = annual decomposition constant.

Litter nutrient analysis

Decomposing litter from litter bags were ground and subjected to nutrient analysis. Carbon (Nelson & Sommers 1982) and nitrogen (Jackson 1973) contents were measured by the dry combustion method. Total phosphorus content was estimated by the method of Fiski-Subba-Rao as modified by Bartlett (1959). Total available potassium was measured using flame photometer. Micronutrients such as calcium, magnesium, iron, zinc, chromium, copper and sodium were estimated using atomic absorption spectrophotometer (Jackson 1973).

Statistical analysis

Relationships between litterfall and nutrient contents were determined using linear regression equation. Significant differences at $p \leq 0.05$ were determined using SYSTAT 10 software package.

RESULTS

Tree growth

The trees attained 2.6 cm diameter at breast height (dbh) with total height of 3.8 m, basal diameter of 12.4 cm and volume of 0.0017 m^3 1 year after planting (Table 1). After 2 years, dbh was 4.6 cm, total height 8.9 m, basal diameter 23.5 cm and volume 0.0118 m^3. At a harvestable age of 3 years, trees attained dbh of 6.5 cm, total height of 13.4 m, basal diameter of 26.5 cm and volume of 0.0372 m^3.

Litter production

Peak period of litterfall was recorded from April till June (Table 2). The annual litter production was at a rate of 0.642 t ha^{-1} $year^{-1}$ in 1-year-old, 4.697 t ha^{-1} $year^{-1}$ in 2- year-old and 5.189 t ha^{-1} $year^{-1}$ in 3-year-old plantations. Relationship between age and litter production of *C. equisetifolia* plantation was positively correlated (Figure 2).

Nutrient return through litter

Nutrient concentration of needle litter was recorded in the order of C > Ca > N > K > Mg > Na > P > Fe > Zn > Cu > Cr in both 2- and 3-year old plantations (Table 3). The percentage of C in needle litter varied from 32.55 to 39.71% in 1- to 3-year-old plantations. Carbon was generally

Table 1 Growth of *Casuarina equisetifolia* at different ages of planting represented by diameter at breast height, basal diameter and volume

Age (years)	Dbh (cm)	Height (m)	Basal diameter (cm)	Volume (m^3)
1	2.60 ± 0.167	3.80 ± 0.054	12.40 ± 0.306	0.0017 ± 0. 00004
2	4.57 ± 0.149	8.85 ± 0.278	23.49 ± 0.667	0.0118 ± 0.00021
3	6.54 ± 0.283	13.39 ± 0.281	26.47 ± 1.224	0.0372 ± 0.00730

Dbh = diameter at breast height; ± standard error

Table 2 Monthly litter production (g m^{-2}) of 1-, 2- and 3-year-old *Casuarina equisetifolia* plantations in farm forestry

Month	Age (years)		
	1	2	3
January	_	35.448 ± 0.924	41.497 ± 1.390
February	_	43.662 ± 1.106	42.262 ± 1.344
March	_	37.089 ± 0.268	43.217 ± 0.879
April	_	53.482 ± 0.397	51.288 ± 1.169
May	_	57.279 ± 0.499	60.443 ± 0.465
June	_	60.254 ± 0.748	64.487 ± 2.055
July	13.991 ± 0.372	40.359 ± 0.701	46.452 ± 1.604
August	13.786 ± 0.662	22.243 ± 0.315	36.277 ± 0.234
September	11.880 ± 0.335	28.960 ± 0.399	28.203 ± 0.676
October	10.130 ± 0.537	23.490 ± 0.322	35.770 ± 0.677
November	8.004 ± 0.456	32.227 ± 0.375	30.552 ± 0.422
December	6.410 ± 0.481	35.296 ± 1.159	38.404 ± 0.425
Total	64.201	469.789	518.852

± Standard error

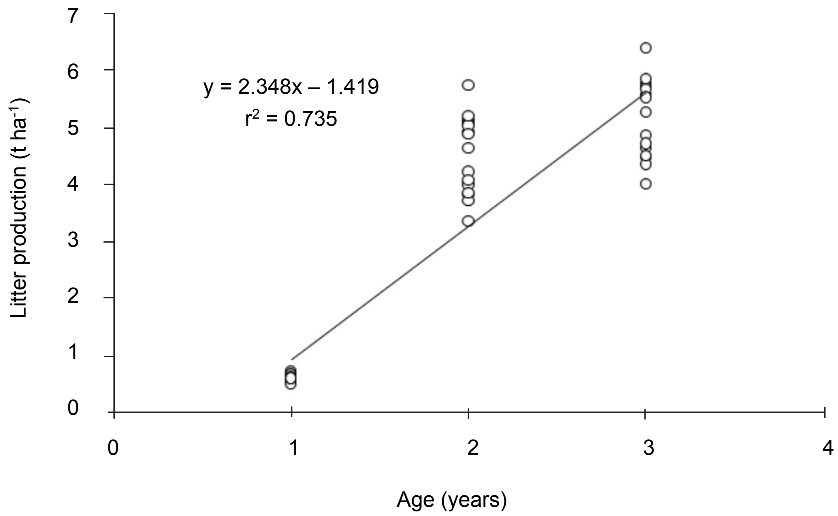

Figure 2 Relationship between age and litter production of 1-, 2- and 3-year-old *Casuarina equisetifolia* plantations in farm forestry

Table 3 Nutrient concentration (%) of litter in *Casuarina equisetifolia* plantation in farm forestry

Year	C	N	P	K	Ca	Mg	Fe	Zn	Cr	Na	Cu
1	32.552 ± 1.338	1.577 ± 0.137	0.182 ± 0.003	0.381 ± 0.033	1.842 ± 0.003	0.308 ± 0.018	0.024 ± 0.004	0.004 ± 0.003	0.0015 ± 0.002	0.250 ± 0.050	0.0037 ± 0.001
2	36.230 ± 2.469	1.617 ± 0.023	0.191 ± 0.003	0.365 ± 0.016	1.925 ± 0.006	0.327 ± 0.022	0.026 ± 0.005	0.005 ± 0.004	0.0016 ± 0.004	0.261 ± 0.014	0.0041 ± 0.003
3	39.707 ± 1.465	1.693 ± 0.025	0.183 ± 0.007	0.364 ± 0.024	1.911 ± 0.027	0.347 ± 0.011	0.027 ± 0.08	0.006 ± 0.005	0.0017 ± 0.007	0.267 ± 0.013	0.0057 ± 0.004

± Standard error

returned to soil in the highest amount, followed by N accumulation. Carbon content of litterfall was highest (2.060 t ha^{-1}) in 3-year-old plantation, followed by 2- and 1-year-old plantations (Table 4). Nutrient return through litter was in the order of Ca > N > K > Mg > Na > P > Fe > Zn > Cu > Cr in all age series (Table 4).

Litter decomposition

The linear regression developed between mass loss of litter and decomposition period (days) showed significant positive correlation ($r = 0.90$, $p \leq 0.05$) (Figure 3). Relative litter decomposition rate was considered monthly and the value of annual decomposition constant was 1.83 (result not shown). Decomposition was faster during the rainy season in November. The linear regressions developed between weight loss of litter and independent climatic variables (temperature, relative humidity and rainfall) as well as carbon of *Casuarina* litter showed significantly positive correlations (Table 5). Higher values for decomposition rate were recorded during the rainy season.

Litter decomposing microorganisms

Seven dominant fungal species were isolated and identified as *Alternaria alternate, Aspergillus niger, Penicilium* sp., *Rhizopus nigricans, Trichoderma viride, Curvularia lunata* and *Curvularia eragrostidis*. Among the bacteria, two dominant species were isolated and identified, namely, *Pseudomonas fluorescens* and *Azospirillum brasilense*. However, basidiocarp of *Pleurotus florida* was predominantly found in litter accumulated in *Casuarina* plantation.

Litter decomposing macroorgasnisms

Populations of macroorganisms capable of decomposing fallen litter of *Casuarina* were *Eudrilus eugeniae* in the count of 3 per 30 cm^2, lancetooth molusca (*Haplotrema vancouverense*) with an average of 2 per m^2 and termites (*Odontotermes obesus*) which were abundant.

Table 4 Litter production (t ha^{-1}), carbon content (t ha^{-1}) and nutrient return through litter (kg ha^{-1}) of 1-, 2- and 3-year-old *Casuarina equisetifolia* plantations in farm forestry

Age (years)	Litter production	C	N	P	K	Ca	Mg	Fe	Zn	Cr	Na	Cu
1	0.642	0.208	10.124	1.168	2.446	11.826	1.977	0.154	0.026	0.010	1.605	0.023
2	4.697	1.698	75.789	8.952	17.108	90.225	15.326	1.219	0.234	0.075	12.233	0.192
3	5.189	2.060	87.850	9.496	18.888	99.162	18.006	1.401	0.311	0.089	13.854	0.295

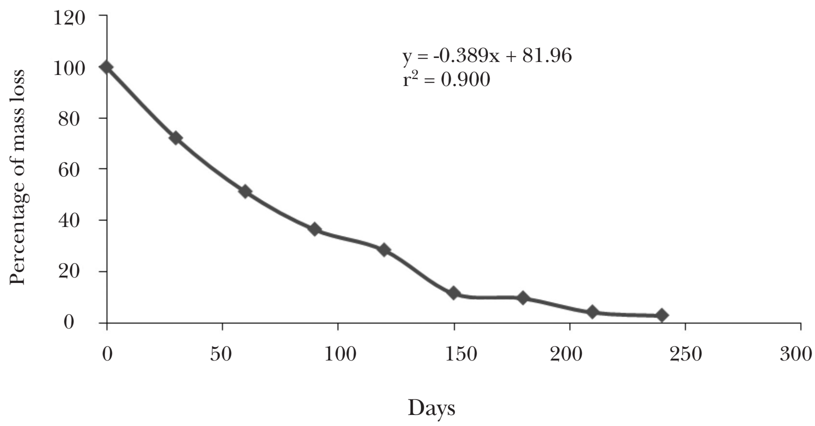

Figure 3 Relationship between days and remaining weight (%) of litter in *Casuarina equisetifolia* plantation

Table 5 Linear regression analyses on loss of litter mass (%) by climatic variables and carbon return of *Casuarina equisetifolia* plantation in farm forestry

Variable	Regression equation	r^2	p
Temperature	y = -6.098x + 236.4	0.717	0.01
Relative humidity	y = -0.092x + 41.97	0.508	0.05
Rainfall	y = -2.185x + 190.5	0.653	0.05
Carbon	y = -4.977x + 215.6	0.597	0.05

DISCUSSION

Tree growth

Results of the present study provide valuable information that supports the establishment of *C. equisetifolia* in farm forestry plantations in semiarid zone. The growth of *C. equisetifolia* increased with light, moisture and available nutrients. Therefore, regular irrigation helps to make nutrient available in the rhizosphere. Beneficial microorganisms may be influenced by plant roots directly in tripartite association between *Casuarina* and *Frankia* and arbuscular mycorrhiza (Reddell 1990, Rajendran & Devaraj 2004). In our study, significant growth was recorded in height (3.80, 8.85, 13.39 m respectively) and dbh (2.60, 4.57 and 6.54 cm respectively) of 1-, 2- and 3-year-old plantations. The values were incomparable with *C. equisetifolia* grown in different parts of the world. A study in the Philippines on the height of 1-, 2- and 3-year-old *Casuarina* recorded 1.6, 2.2 and 2.5 m respectively with corresponding dbh of 0.6, 1.8 and 2.6 cm (Halos 1983). Height was 204.8 cm and diameter 3.6 cm after 2 years under arid conditions in Egypt (el-Lakany 1983). The overall growth improvement may be attributed to improved genetic material available. Accumulation of biomass may be related to intensive silvicultural management such as superior genetic materials, appropriate distance, regular watering, weeding and manuring. However, growth of trees was markedly higher while adopting systematic cultivation method using suitable biofertilisers. In addition, excellent growth was observed in the height of *C. equisetifolia* which ranged from 9.87 to 11.90 m and girth at breast height which ranged from 16.8 to 23.2 cm 2 years after planting (Rajendran & Devaraj 2004).

Litter production

Biomass production is directly related to the availability of plant nutrients and fast growth of the species. Due to high density plantations (10,000 trees ha^{-1}), there is more pressure on soil nutrients as more number of trees are present in a unit area. However, some amount of nutrient is returned to the soil through leaf litter. In the present estimation, litterfall was unimodal and directly proportional to the age of plantation. No detectable amount of litterfall was found in the initial establishment during the first 6 months after establishment of plantation. There was positive correlation between age and litter production of *C. equisetifolia* in high density farm forestry plantation in semiarid zone (Figure 2). The periodicity of the litter fall was unimodal and maximum litterfall was found during rainless summer months (April till June). This coincided with drier periods of the year when evapotranspiration and temperature were on the rise. In the present estimate of litter production, the value 5.189 t ha^{-1} in 3-year-old plantation was higher compared with litter production of 4.323 t ha^{-1} in plantation forestry in the east coast district of Tamil Nadu, India (Rajendran 2001). This shows that intensive management may help increase litter production and nutrient recycling. Litter accumulation in 3.5-year-old *C. equisetifolia* plantation in Puerto Rico was higher (16.2 t ha^{-1} $year^{-1}$; Lugo et al. 1990) than that of the present study. Similarly, 3-year-old *C. glauca* recorded the highest litter of 848 g m^{-2} compared with temperate and subtropical forests in Australia (Clarke & Allaway 1996).

Nutrient return through litter

Carbon content of litterfall was higher in 3-year-old followed by 2-year-old plantations (Table 4).

Similar order was also reported in *C. equisetifolia* plantation at Coimbatore, Tamil Nadu, India (Rajendran & Devaraj 2004). Nutrient cycling was high in 3-year-old *C. equisetifolia* plantation due probably to more litter production and nutrient concentration. Litter nutrient content varied from 100 to 256 kg ha^{-1} for N, 11 to 18 kg ha^{-1} for K, 45 to 150 kg ha^{-1} for Ca and 13 to 29 kg ha^{-1} for Mg (Wang et al. 1991). Litter production was 0.857 kg $tree^{-1}$ for trees planted on farmland and nutrient contents of 2-year-old trees were 4.87, 0.22, 5.02, 4.59 and 0.52 g $tree^{-1}$ for N, P, K, Ca and Mg respectively as reported by Rajendran and Devaraj (2004).

Litter decomposition

The higher rate of litter production and its subsequent decomposition under tropical climate contributed to the rapid turnover of nutrients and affected nutrient cycling. Litter quality has been considered as an important factor controlling decomposition (Ribeiro et al. 2002, Tateno et al. 2007). In the present study, the annual decomposition constant was 1.83, which was not in agreement with the decay coefficient observed in *Cunninghamia lanceolata* 0.71, *Michelia macclurei* 0.99 (Wang et al. 2008), sal 1.668, *Eucalyptus* 1.165 and *Pinus roxburghii* 1.350 (Pande & Sharma 1993).

The processes of leaf decay are largely controlled by soil microorganisms and are, therefore, influenced by temperature, moisture, pH and soil microorganisms (Jenkinson 1981). Maximum decomposition was recorded during the rainy season followed by winter and summer. This is obvious from the positive correlation between the rate of weight loss and soil moisture and rainfall (Austin & Vitousek 2000, Dasselar & Latinga 2000). The high rate of decomposition (rainy season) attributable to suitable temperature and moisture was due to regular irrigation, rainfall, fungal population and soil aeration. Similar observations were observed for *Eucalyptus, Dipterocarpus tuberculatus* and oak conifer forest (Wedderburn & Carter 1999, Sarjubala & Yadav 2007).

Litter decomposing microorganisms

Decomposition of organic matter and nutrient mineralisation from decaying litter are important for ecosystem functioning, particularly high density plantation in farm forestry. Decomposition rates are influenced by litter quality, species composition of decomposers and environmental conditions (Swift et al. 1979, Couteaux et al. 1995). We found that macro- and microorganisms as well as termites actively promoted litter decomposing. In the litter of *Casuarina,* termites (*O. obesus*) were exceedingly abundant.

Earthworm can influence the rate of litter decomposition more than any soil organism. In our study, earthworm population of 3 per 30 cm^2 and lancetooth mollusca (*H. vancouverence*) were predominantly found in the litter accumulated in the plantation. We also found basidiocarp of oyster mushroom *P. ostreatus*. This species has great diversity due to its adaptation to the varying climatic conditions as well as its ability to degrade locally available lignocellulosic substrates. Basidiomycete fungi play an important role in decay. *Casuarina* litter supports the growth of fungi and can be used for mushroom cultivation by farmers.

Different fungal species fluctuate in soil as well as in leaf litter. *Trichoderma, Aspergillus* and *Penicillium* are predominant occurrences in soil and litter fungi and have been found to be effective decomposers (Panda et al. 2007). In the present study, the seven dominant fungal species isolated and identified were *A. alternate, A. niger, Penicilium* sp., *R. nigricans, T. viride, C. lunata* and *C. eragrostidis*. These fungal species have the ability to degrade available lignocellulolytic substrates of *C. equisetifolia* litter.

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