ELSEVIER

Forest Ecology and Management 130 (2000) 265–268

Forest Ecology and Management

www.elsevier.com/locate/foreco

Estimation of litter fall and seed production of *Acacia mangium* in a forest plantation in South Sumatra, Indonesia

Bambang Hero Saharjo[a,*], Hiroyuki Watanabe[b]

[a]*Laboratory of Forest Protection, Division of Forest Management, Faculty of Forestry, Bogor Agricultural University, PO BOX 168, Bogor 16001, Indonesia*

[b]*Laboratory of Tropical Forest Resources and Environments, Division of Forest and Biomaterials Science, Graduate School of Agriculture, Kyoto University, Kyoto 606-8502, Japan*

Received 3 April 1998; received in revised form 27 August 1998; accepted 27 May 1999

Abstract

Annual litter fall of *Acacia mangium* in the period of September 1995 to August 1996 was estimated at 5939 kg ha^{-1} year^{-1} and from September 1995 to August 1996 at 6048 kg ha^{-1} year^{-1}, with the highest seasonal production in the dry season. The litter fall was dominated mainly by leaves, 4446 kg (75%) and 4137 kg (68%), respectively. Seed production in the litter fall was estimated at 42.4 kg ha^{-1} year^{-1} (4.1 million seeds ha^{-1}) and 39 kg ha^{-1} year^{-1} (3.8 million seeds ha^{-1}), with the highest in the dry season from June to October. The accumulated litter fall in the forest floor together with shrubs and grass provide a high fuel load, increasing fire risk.

Keywords: *Acacia mangium*; Forest fire; Litter fall; Plantation; Seed

1. Introduction

One of the reasons why industrial forest plantations are valuable is the high demand for raw materials which increases year by year. To guarantee the sustainability of these raw materials, a million hectare of industrial forest plantations needs to be established mainly located in Sumatra and Kalimantan islands at a rate of 500,000 ha year^{-1}. Without this, the natural rain forest remaining will surely be sacrificed (Saharjo, 1997a).

Many factors, however, affect the success of forest planting, and one of these is forest fire. One of the reasons why so much of the *Acacia mangium* plantation was destroyed was the high level of fuel stored in the forest floor. Highly available fuel in those plantations consisted mainly of dead materials (litter fall) that accumulated in the forest floor, coupled with underground vegetation. Dead leaves and other loose litter on the ground constitute a highly flammable surface layer (Brown and Davis, 1973).

Another factor that disturbs the performance of vegetation comes from the high availability of seed stored in *A. mangium* plantations (Saharjo, 1997b). These seeds are not good because the quality of the

* Corresponding author. Tel.: +62-251-627-750, fax: +62-251-621-244.
E-mail address: sifahut@bogor.wasantara.net.id (B.H. Saharjo)

0378-1127/00/$ – see front matter
PII: S0378-1127(99)00189-9

resulting trees is very bad. If this seed is not reduced it will affect the performance of the trees itself.

This research therefore was conducted in order to estimate the production of annual dead material (litter fall) and seed of *A. mangium*, and also to make a prediction on when fire will invade.

2. Material and methods

2.1. Area description

The study was carried out from September 1995 to August 1997 in a newly established *A. mangium* plantation established in 1990 at a 3 m × 3 m spacing. The mean tree diameter is 13.7 cm, height is 15.1 m and tree density 1111 ha^{-1} (Table 1). The plantation is located in Gemawang unit, Subanjeriji forest block, and belongs to one forest concession area in South Sumatra, Indonesia. To date, about 200,000 ha have been planted.

The mean annual rainfall is about 2800 mm, with a monthly rainfall of 208.5 mm ranging from 92 mm in July to 278 mm in February. According to the system of Schmidt and Fergusson (1951), the climate of this area is classified as rainfall type A. The mean maximum air temperature in the area is 32.6°C in August, mean minimum air temperature is 22.6°C in December, and mean annual relative humidity is about 85%.

Underground vegetation is dominated by Imperata cylindrica, Eupatorium pubescens, Clidemia hirta, Tetracera spp., Artocarpus anisophyllus, Macaranga javanica, and Dillenia grandifolia.

2.2. Method

In this study, 20 litter traps, 1 m^2 with a depth of 30 cm, were suspended randomly at a 62.5 m × 33.5 m sample plot. The traps were made from fine nylon mesh cloth (1 mm mesh size) joined in the tree stems, and the mouths of these traps were supported horizontally. All accumulated material in the traps were collected and calculated every 2 weeks from September 1995 to August 1997. The materials were sorted into leaves, flowers, pods, branches, seeds and unidentified materials, and the dry weight was obtained after the materials were kept in an oven at 105°C for 24 h.

Table 1
Description of growth performance of trees in the research site

Parameters	September 1995	September 1996
Mean d.b.h (cm)	(13.7 ± 1.3)	(14.9 ± 2.3)
Mean height (m)	(15.1 ± 0.7)	(18.7 ± 0.5)
Tree density (N ha^{-1})	1111	1111
Basal area (m^2 ha^{-1})	22.2	24.9

3. Results and discussion

Total litter fall in the first year of research (September 1995 to August 1996) was estimated at 5939 kg ha^{-1} and in the second year (September 1996 to August 1997) 6048 kg ha^{-1} (2% increase). The highest seasonal litter fall was found in August 1996 at 701 kg, while the lowest was in February 1997 at 29.4 kg (Fig. 1). Those litter fall (Table 2) were dominated mainly by leaves at 4446 kg (75%) in the first year and 4137 kg (68%) in the second year. Leaf fall continued through the year, peaking in the dry season at 505 kg in September 1995, 536 kg in August 1996 and 571 kg in June 1997 (Fig. 1).

Flowering peak was estimated at 39.4 kg in June 1996 and 41.9 kg in July 1996, while pod peak was estimated at 127 kg in December 1996, 116 kg in July 1997 and 165 kg in August 1997. In terms of flowering and seed production, development time is shorter for the Indonesian provenance (Awang and Bhumibhamon, 1993).

Seed production with the characteristics as shown in Table 3 was estimated at 42.4 kg (4.1 million seeds) in the first year and 39 kg (3.8 million seeds) in the second year (Fig. 2). The highest production of seed in litter fall was found in October 1995 at 5.4 kg ha^{-1}, December 1995 at 9.9 kg ha^{-1}and in September 1996 at 9.9 kg ha^{-1}. The data shows that the highest production of litter fall was during the periods of October 1995 to January 1996 and July 1996 to January 1997. In a 1-year-period, the highest estimated production of seeds was in January and in the period from July to December.

Annual total litter fall in the studied plantation was estimated at about 6 tonne ha^{-1} with the highest production in the dry season, from June to October. The accumulated litter, together with underground vegetation, *Imperata cylindrica* (alang–alang grass) and

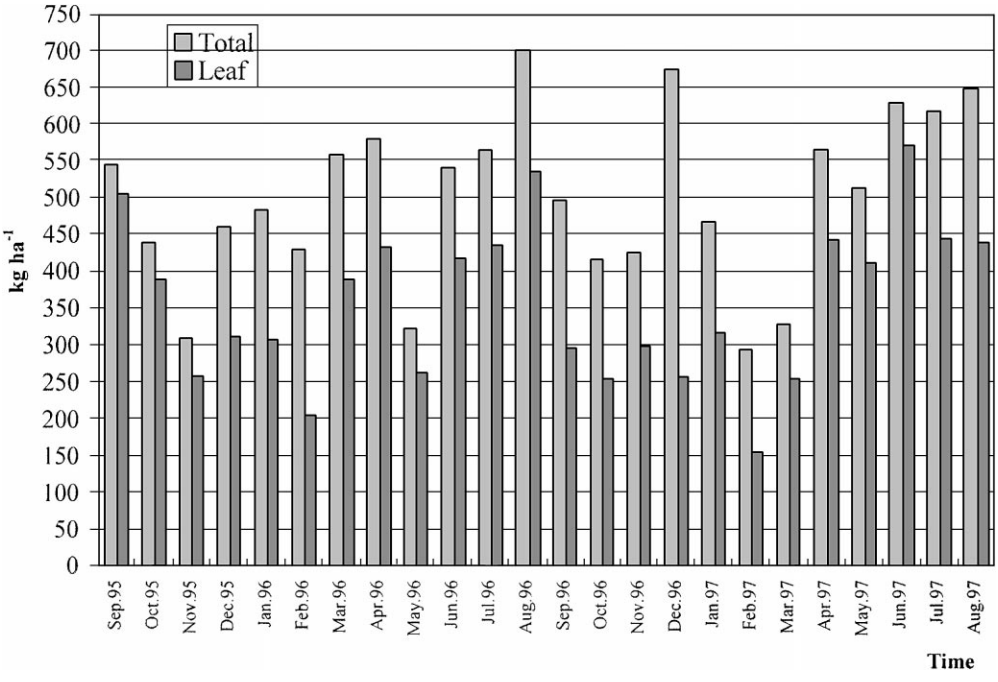

Fig. 1. Seasonal fluctuation of total litter fall and leaf from September 1995 to August 1997.

shrubs provide enough fuel for fire to occur. Total available fuel in the forest floor will be approximately 16–18 tonne ha^{-1}. In addition, tree maintenance activities, i.e., weeding, slashing and pruning and the low rate of decomposition of *A. mangium* materials result in an increasing danger of fire.

4. Conclusion

Annual litter fall was estimated at 5.9 tonne ha^{-1} $year^{-1}$ in the period of September 1995 to August 1996 and 6.0 tonne ha^{-1} $year^{-1}$ in the period of September 1996 to August 1997. Litter fall was dominated by leaves estimated at 4.4 tonne ha^{-1} $year^{-1}$ (75%) and 4.1 tonne ha^{-1} $year^{-1}$ (68%), with the highest production in the dry season. Seed production was estimated at 42.4 kg ha^{-1} $year^{-1}$ (4.1 million seeds ha^{-1}) and 39 kg ha^{-1} $year^{-1}$ (3.9 million seeds ha^{-1}) respectively, with the highest production in the dry season, from June to October.

The accumulation of litter fall in the forest floor together with dry shrubs and 'alang–alang' (*Imperata cylindrica*) grassland create a highly flammable surface layer, especially in the dry season.

Table 2
Amount of each component in litter fall (dry weight kg ha^{-1} $year^{-1}$)

Parameter	September 1995 to August 1996	%	September 1996 to August 1997	%
Leaf	4446	75	4137	68
Branch	556	9.4	909	14.9
Pod	723	12	856	14
Flower	154	2.6	119	2.0
Seed	42.4	0.7	39	0.6
Unidentified material	17.8	0.3	24.3	0.4
Total	5939		6084	

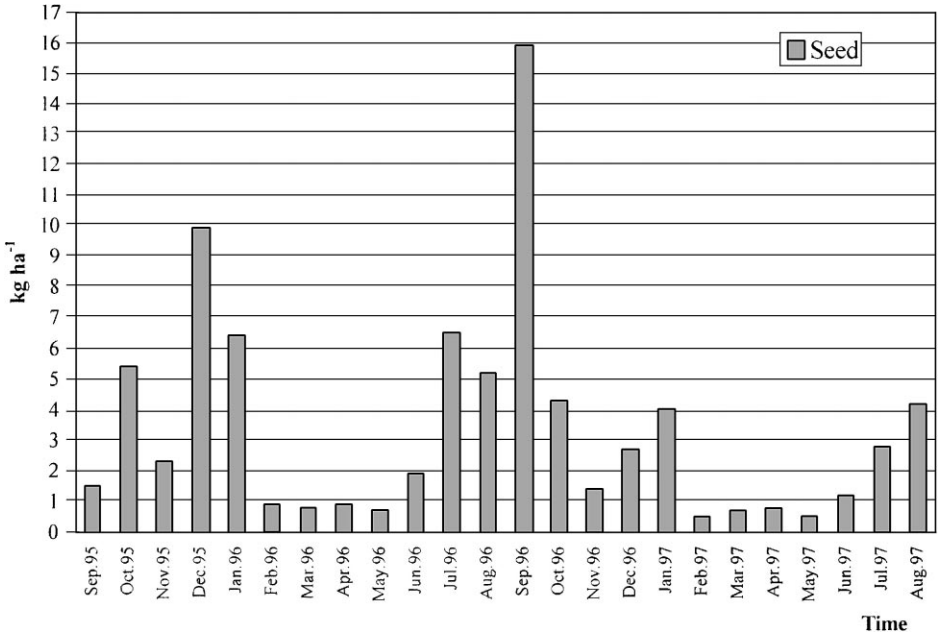

Fig. 2. Seasonal fluctuation of seeds in litter fall from September 1995 to August 1997.

Table 3
Seed characteristics

Length (cm)	(0.42 ± 0.02)
Width (cm)	(0.27 ± 0.02)
Number of seeds (N g^{-1})	(96.6 ± 3.5)
Moisture content (%)	(7.7 ± 0.7)

References

Awang, K., Bhumibhamon, S., 1993. Genetics and tree improvement. In: Awang, K, Taylor, D. (Ed.), *Acacia mangium*: Growing and Utilization, Winrock International and FAO, Bangkok, pp. 35–57.

Brown, A.A., Davis, K.P., 1973. Forest Fire: Control and Use, 2nd ed., McGraw-Hill, New York, 658 pp.

Saharjo, B.H., 1997a. The role of industrial forest plantation in supporting pulp and paper industries: a case study in South Sumatra, Indonesia. In: Proceeding of the 6th Annual International workshop BIO-REFOR, 2–5 December 1997, Brisbane, Australia, pp. 12–15.

Saharjo, B.H., 1997b. Fire protection and industrial forest management in the tropics. Commonwealth Forestry Review 76 (3), 203–206.

Schmidt, F.H.A., Fergusson, J.H.S., 1951. Rainfall type based on wet and dry periods of ratios from Indonesia with Western New Guinea, Verhandelingen No.42, Directorate Meteorology and Geophysics, Jakarta, 77 pp.