INFESTATION OF *XYSTROCERA FESTIVA* IN *PARASERIANTHES FALCATARIA* PLANTATION IN EAST JAVA, INDONESIA

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ENDANG AH & NOOR FARIKHAH H. 2010. Infestation of *Xystrocera festiva* in *Paraserianthes falcataria* plantation in East Java, Indonesia. Sengon (*Paraserianthes falcataria*) is an exceptionally fast-growing tree species native to eastern Indonesia and Papua New Guinea. A serious problem encountered by sengon plantation in western Indonesia is the infestation of stem borer (*Xystrocera festiva,* Coleoptera, Cerambycidae). This study was aimed at characterising the borer infestation. The per cent of insect infestation increased with age of the stand. The rate of damage was affected by the number of larvae and/or boring tunnels. *Xystrocera festiva* can infest all diameters of trees at a certain age of sengon stand. The damaged parts of the tree were located between 3.4 and 7.5 m above the ground.

Keywords: Sengon, *Phaedologeton*, lower-end infestation, upper-end infestation, boring tunnels, stem borer

ENDANG AH & NOOR FARIKHAH H. 2010. Serangan *Xystrocera festiva* di ladang *Paraserianthes falcataria* di Jawa Timur, Indonesia. Pokok batai (*Paraserianthes falcataria*) merupakan sejenis pokok cepat tumbuh yang hidup secara semula jadi di timur Indonesia dan di Papua New Guinea. Masalah utama di ladang batai di timur Indonesia ialah serangan kumbang bubuk (*Xystrocera festiva*, Coleoptera, Cerambycidae). Kajian ini bertujuan untuk mencirikan serangan kumbang bubuk tersebut. Peratus serangan didapati meningkat dengan umur dirian. Kadar kerosakan dipengaruhi oleh bilangan larva dan/atau lubang yang ditebuk. *Xystrocera festiva* boleh menyerang semua kelas diameter pokok pada umur dirian tertentu. Serangan berlaku pada ketinggian antara 3.4 m hingga 7.5 m dari permukaan tanah.

INTRODUCTION

Sengon (*Paraserianthes falcataria*) is a fast-growing tree species that can be harvested within a relatively short period. In East Java, the trees are usually harvested at eight years. Sengon is commonly planted by farmers in the rural areas of Java. Nowadays, many companies are planting this fast-growing tree in industrial forest plantations either in state or private lands.

Sengon forest plantations, either in monoculture or mixed plantation, is not free from insect pests. One of the most damaging pest is Xystrocera festiva. The insect attacks sengon trees when they are three years old. Xystrocera festiva is distributed in western Indonesia (Java, Sumatra, Kalimantan), infesting many species of trees belonging to the family Fabaceae, such as *Acacia arabica, Acacia auriculiformis, Acacia catecu, Acacia mangium,* hybrid (*A. mangium* × *A. auriculiformis*), *Acacia vera, Albizia chinensis, Albizia lebbeck, Albizia sumatrana, Caliandra callothyrsus, Enterolobium cyclocarpum, Paraserianthes falcataria, Pithecelobium jiringa, P. dulce, Parkia speciosa* and *Samanea saman* (Notoatmodjo 1963, Matsumoto 1994).

Infestation of *X. festiva* in sengon plantations begins with the female beetle laying egg cluster or clusters in bark crevices or wounds on the stem or branch of the tree. The newly hatched larvae feed gregariously on the inner part of the bark and the outer part of sapwood, forming small feeding tunnels as deep as 0.5 cm. The tunnels run downwards from the site of the egg cluster. Towards the lower part of the sengon stem these feeding tunnels become wider because the larvae have grown larger. From small holes on the bark, the larvae push out frass and brown liquid. The presence of frass and brown liquid attached to the bark or frass on the forest floor shows the typical symptoms of pest attack.

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When matured (prepupal stage), each larva constructs a J-shaped tunnel upwards in the sapwood. The length of the boring tunnels is 6 to 18 cm. The boring tunnels are oval in shape and of dimensions 1.5–2 cm long and 0.7 cm wide. The larvae pupate at the end of the boring tunnels. Before pupating, the individual larva makes a chamber for pupating. The chamber is made of thin lime crust ($CaCO_3$) (Notoatmodjo 1963). The length of boring tunnels varied with the diameter of the stem (Table 1). There were positive linear correlations between stem diameter and length of boring tunnel ($Y = 8.13 + 0.34 X$; $r^2 = 0.52$) and between stem diameter and number of boring tunnels ($Y = 9.37 + 2.29 X$; $r^2 = 0.85$).

When pupal development is complete, the beetles will emerge from the boring tunnel by breaking the lime crust and moving downwards to the exit hole and then puncturing the tree bark previously not eaten by the larvae. The newly emerged beetles will stay for some time on the surface of the bark near the exit hole and then fly or crawl upwards on the stem of the infested tree (Matsumoto 1994). The flying distance of the beetle is not far, 3–4 m (Natawiria 1973).Thus, attack by *X. festiva* tends to be clustered and often a stem of sengon is attacked several times.

Infestation of *X. festiva* could reduce the volume and quality of sengon timber. The financial losses in unthinned sengon stands in Gerbo area (East Java) ranged from 11.7% on four-year-old stands to 73.5% on eight-year-old stands (Notoatmadjo 1963). A yearly thinning operation was conducted on sengon stands in Kediri Forest District, East Java, from stands of three to six years old. At eight years, the stands were clear cut. This thinning operation resulted in lower financial losses, ranging from 4.2% on four-year-old stands to 10.7% on eight-year-old stands (Husaeni 1992).

Many studies have been conducted to characterise the borer attack, especially on per cent of infestation and the loss caused by the borer. The objective of this research was to characterise the borer attack on sengon trees in forest plantations. The aspects studied were length of stem destroyed, unsuccessful larval development, number of larvae and boring tunnels per stem, and diameter distribution of infested trees.

MATERIALS AND METHODS

The research was conducted on three- to seven-year-old sengon plantations in Ngancar forest area located in Pandantoyo Forest Ranger, Pare Subforest District, Kediri Forest District, managed by State Forest Enterprise Unit II East Java (Perum Perhutani Unit II Jawa Timur). The sengon in Ngancar area grow on volcanic regosol soil in a level terrain. The climate is humid (rainfall type C according to Schmidt and Ferguson 1951). The initial tree spacing was 1–3 m. The plantations were thinned at regular intervals when stands were three, four, five and six years old.

A number of circular sample plots (SPs) (each with a radius of 17.8 m and 0.1 ha in size) were established in a systematic pattern in each plantation. The SPs were located at equidistance of 100 m (sampling intensity 10%). In each SP, observation, measurement and counting were conducted:

(1) Counting the total number of trees.
(2) Counting the number of trees attacked by the borer.
(3) Identifying and counting trees having unsuccessful larval development. Unsuccessful

Table 1 Number and the length of larval boring tunnels in sengon stem

Diameter class (cm)	Number of boring tunnels in one meter log		Length of boring tunnel (cm)	
	Range	Average	Range	Average
10–15	16–25	20.8	10–14	12
15–20	25–40	32.3	13–16	14.5
20–25	36–50	43.3	15–18	16.4
25–30	49–62	55.2	16–19	17.4

Source: Darmawan (1976)

larval development is referred to as the failure of larvae to continue their life cycles before they tunnel into the sapwood because of attack by natural enemies.

(4) Measuring the full height and height of clear bole of trees, and tree diameter at breast height (dbh).
(5) Counting the number of larvae and or boring tunnels in each of the infested tree.
(6) Measuring the upper and lower limits of the stem which was damaged to obtain the length of tree stem damaged.

The diameters of all trees of a certain age in the plantation were grouped into diameter classes and a curve of diameter distribution was established. A curve of diameter distribution of the infested trees was also established.

RESULTS AND DISCUSSION

Percentage infestation

The percentage of infestation by *X. festiva* tended to increase with increasing age of the sengon stand (Table 2). Matsumoto (1994) also found increasing per cent of *X. festiva* infestation in Ngancar area. A positive correlation was found between sengon tree diameter and per cent infestation of *X. festiva* in Cicurug area, West Java (Wongtong 1974).

Per cent of trees with unsuccessful larval development

A number of infested sengon trees were found to be not containing larval colonies or upward boring tunnels in the sapwood. The larvae were heavily attacked by predaceous red ants before they could damage the tree by boring tunnels. The predaceous red ant was identified by Notoatmodjo (1963) as *Phaedologeton* sp.

Unsuccessful larval development was found in each age of sengon stand. The per cent of unsuccessful larval development fluctuated independent of the age of the sengon stand (Table 2).

Number of larvae and boring tunnels

The level of damage on sengon tree was affected by the number of *X. festiva* larvae and/or the number of boring tunnels present in a stem. The number of larvae per tree increased from the stand age of three to four years. However, the number decreased again after the sengon stand reached five years old. Nevertheless, the number was still higher compared with the number of larvae and boring tunnels per tree at the stand age of three years (Table 2).

Observation by Matsumoto (1994) in the same area showed different results. The number of larval colonies undergoing pupation increased progressively with increasing age of sengon stand. It was presumed that tree diameter at a young stand was too small to support larval development, so the colony size was small or the colony disappeared completely. Larval population per hectare increased from stand age of two to four years and then decreased. However, if the number of larvae was counted per 100 tree basis, the larval population increased from stand age of two to five years and then stabilised.

Table 2 Percentage of infestation of *X. festiva* on three- to seven-year-old sengon plantations

Stand age (years)	Number of trees ha^{-1}	Number of infested trees ha^{-1}	Number of trees with unsuccessful larval development ha^{-1}	Number of larvae per infested tree	Number of boring tunnels per infested tree
3	1285.0	30.0 (2.3)	7.5 (25.0)	13.6	9.0
4	832.7	48.8 (5.9)	16.3 (33.4)	35.9	27.6
5	805.0	84.0 (10.4)	13.0 (15.5)	23.0	15.7
6	561.8	64.5 (11.5)	8.1 (12.6)	15.5	17.4
7	455.0	67.5 (14.8)	15.0 (22.2)	17.2	14.8

Values in parentheses indicate percentages.

Diameter distribution of infested trees

Pest attack is affected by the condition of the trees. Suppressed or stressed trees can reduce their resistance to pests and diseases (Suratmo 1982, Speight & Wylie 2001). Stress in trees is usually due to biotic and abiotic factors (Barbosa & Wagner 1989).

However, there are several insect pests which prefer healthy trees to stressed ones (Speight & Wylie 2001). Forest stands could suffer considerable severe attack. The study showed that *X. festiva* could attack any diameter class of sengon trees within stand of a certain age (Figure 1). This indicates that *X. festiva* does not have specificity on the size of trees. In order to prevent more widespread infestation, sources of infestation, namely, all trees that have been attacked should be cut during thinning.

Position of attack

Attack by *X. festiva* started from the sites where eggs were laid. The larvae damaged the sengon stem downwards. There is a boundary of damage on the upper and lower ends of a sengon stem. The damage on the upper and lower ends varied according to the age of the sengon stand (Tables 3 and 4). No female beetles laid their eggs on the part of stem lower than 1.5 m from the ground in the upper-end infestation. In all stand ages, egg-laying sites were mostly between 3.5 and 7.5 m from the ground (Table 3). There was a tendency that the older the stand age, the higher the sites of egg deposition.

In the lower-end infestation (Table 4), egg laying sites were from the ground surface up to 12.8 m (not shown). The variation in the lower end was affected by stem diameter and number of larvae. The smaller the stem diameter the longer would be the part of damaged stem, some reaching the ground surface. With the upper and lower ends damaged on each tree there would be a certain length of the stem undamaged. The length of the damaged stem had a negative correlation with stem diameter (Figure 2). In the three-year-old stand, the location of the end of attack was mostly between 1.5 and 3.5 m, while in older stands, between 1.5 and 5.5 m. The length of stem damaged was generally between 1.5 and 3.5 m (Table 5).

CONCLUSIONS

At a certain stand age, *X. festiva* attacked all the diameter classes. The diameter curve of the attacked trees followed normal distribution (bell-shaped curve), as was the diameter distribution of all the trees in the stand.

The per cent infestation of *X. festiva* increased with age of stand. The number of larvae and boring tunnels per infested tree increased from three- to four-year-old stands and then decreased. The number of larvae and boring tunnels per

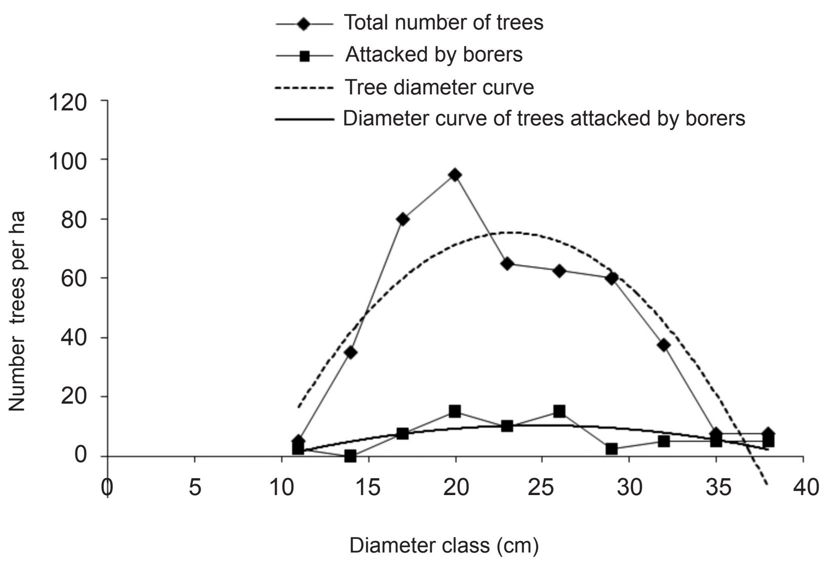

Figure 1 Diameter distribution of sengon trees and sengon trees attacked by *X. festiva* in a seven-year-old sengon stand

Table 3 Number of sengon trees per hectare attacked by *Xystrocera festiva* based on upper end infestation

Height above ground (m)	Age of sengon stand (years)				
	3	4	5	6	7
1.5–3.5	0	1.3	0	0	5.0
3.5–5.5	22.5	13.7	12.0	10.0	5.0
5.5–7.5	2.5	22.5	32.0	25.4	27.2
7.5–9.5	5.0	7.5	25.0	15.4	2.5
9.5–11.5	0	2.5	8.0	7.3	15.0
11.5–13.5	0	1.3	6.0	6.4	7.5
13.5–15.5	0	0	1.0	6.4	5.0
Number of trees ha^{-1}	1285.0	832.7	805.0	661.8	455.0
Average height of tree (m)	12.0	17.1	17.5	21.5	25.7
Clear bole height (m)	5.4	7.8	10.8	15.1	19.0

Table 4 Number of sengon trees per hectare attacked by *Xystrocera festiva* based on lower end of infestation

Height above ground (m)	Age of sengon stand (years)				
	3	4	5	6	7
≤ 1.5	0	1.3	0	0	5.0
1.5–3.5	22.5	13.7	12.0	10.0	5.0
3.5–5.5	2.5	22.5	32.0	25.4	27.2
5.5–7.5	5.0	7.5	25.0	15.4	2.5
7.5–9.5	0	2.5	8.0	7.3	15.0
9.5–11.5	0	1.3	6.0	6.4	7.5
11.5–13.5	0	0	1.0	6.4	5.0
Number of trees per ha^{-1}	1285.0	832.7	805.0	661.8	455.0
Average height of tree (m)	12.0	17.1	17.5	21.5	25.7
Clear bole height (m)	5.4	7.8	10.8	15.1	19.0

Table 5 Number of sengon trees per hectare attacked by *Xystrocera festiva* based on the length of damaged stem

Length of attacked stem (m)	Age of sengon stand (years)				
	3	4	5	6	7
< 1.5	0	7.5	0	4.5	7.5
1.5–3.5	20	36.3	74	43.6	55
3.5–5.5	10.0	5.0	10.0	16.4	5.0
Total	30	48.8	84	64.5	67.5

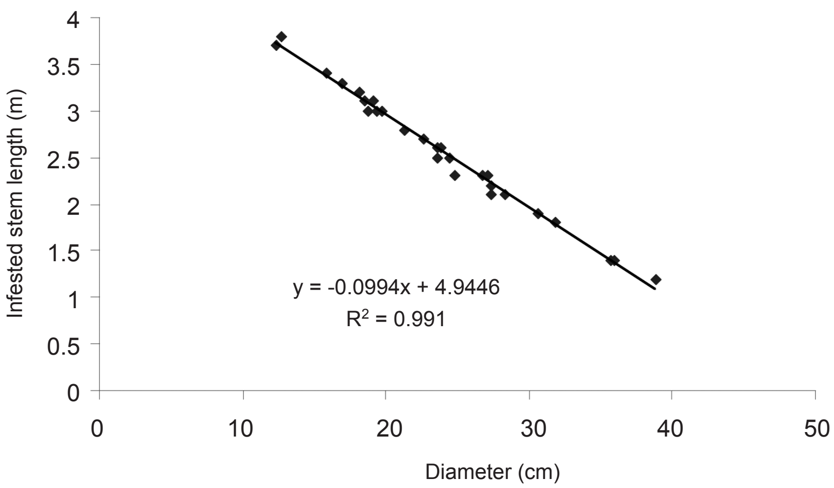

Figure 2 Correlation between stem diameter and the length of stem attacked by *Xystrocera festiva*

hectare increased from three- to five-year-old stands and then decreased. The percentage of unsuccessful larval development fluctuated in each stand, regardless of age. The unsuccessful infestation was probably due to attack by red ants. *Xystrocera festiva* could attack sengon trees up to 15 m above the ground. In a three-year-old sengon stand, the initial attack (oviposition stage) was mostly at the range of 3.5 to 5.5 m above the ground and in older stands, between 5.5 and 7.5 m. The older the stand, the initial attack tended to be higher. The end of infestation in the lower part of the stem could reach ground level. The damaged part will impair cutting during harvesting. A negative linear correlation existed between the diameter of the tree and the length of the damaged stem.

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