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MANAGEMENT OF THE SHOOT BORER HYPSIPYLA ROBUSTA (LEPIDOPTERA: PHYCITIDAE) IN MAHOGANY PLANTATIONS

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ABSTRACT

In Kerala, an area of 170 ha has been planted with mahogany (*Swietenia macrophylla* King).The main pest which infests young plantations of this species is the shoot borer, *Hypsipyla robusta* Moore (Lepidoptera: Phycitidae). A study conducted during 1994-96 in selected young plantations of mahogany at Punalur and Nilambur has revealed that the generations of *H. robusta* are either continuous or overlapping. In some plantations, even up to 90% of the trees were affected by this borer. The pattern of population fluctuated with production of new shoots. The pest was found only on tender shoots and occasionally under bark. In the field, a parasitic nematode (*Hexamermis* sp.) was found to cause mortality of the larvae of *H. robusta.*

Once infested, the borer spreads to the nearby areas. Age of the trees (trees less than 8 years of age are more infested) and availability of tender shoots are the two important factors which determine the survival and level of population of the pest. In older plantations (above 8 years of age) the population of the borer is not very conspicuous as evidenced by the lesser number of borer holes per tree. Evidence of a new infestation in the appearance of a sleeve-like structure made of frass and excreta at the base of new leaves on the shoot. Once established in the shoot, the borer continues to feed the inner part. If no tender shoots are available, the larvae establish under the bark.

1. INTRODUCTION

Mahogany (*Swietenia macrophylla* King) belongs to the family Meliaceae. It is one of the best-known and valuable tropical timbers used mainly for construction purposes, furniture and shipbuilding. Trees belonging to the genus *Swietenia* L., *Khaya* Jass and *Entandrophragma* C. De. of the family Meliaceae, are traded as mahogany. *Swietenia* comprises three species namely, *S. macrophylla* King, *S. mahagoni* (L) Jacq. and *S. humilis* Duce.

S. mahagoni is native to southern Florida (USA) and the Greater Antilles. *S. humilis* is distributed along the Pacific Coast in the dry forest typical of the region. *S. macrophylla* is the most widespread species occupying principally the Atlantic regions of South Eastern Mexico, Central and South America.

Mahogany plantations have been established in over 40 countries around the world. The typical mahogany growing countries include Indonesia with ca.116282 ha (Noltee, 1926), Fiji (42,000 ha), the Philippines (25,000 ha) (Chinte, 1952), Sri Lanka (4500 ha), Guadeloupe (4200 ha), Solomon Islands (3100 ha), Western Somoa (2300 ha) and Martinique (1500 ha).

Cultivation of mahogany was first attempted in India in 1795, when plants from the West Indies were introduced into the Royal Botanic Gardens, Calcutta (Troup,1921). In South Malabar (Kerala), planting of mahogany, both *S. macrophylla* and *S. mahagoni,* was initiated in 1872 and was continued in different localities subsequently. Plantations of both *S. macrophylla* and *S. mahagoni* were raised as early as in 1893 at Edacode in Nilambur.

INSECT PESTS OF MAHOGANY

A number of insects attacking mahogany, have been reported from all over the world (Table1). However, the shoot borer, *Hypsipyla grandella* (Zeller) and *H. robusta* (Moore) (Lepidoptera: Phycitidae) are the major pests. *H. grandella* is found throughout Central and Southern America (except Chile). It also occurs in many Caribbean Islands and southern tip of Florida (Entwistle, 1967). The closely related *H. robusta* is widely distributed throughout West and East Africa, India, Indonesia, Australia and South East Asia (Entwistle, 1967) and in Western and Central Solomon Islands (Oliver, 1992). Mahogany plantations in Kerala were found to be severely affected by *H. robusta* during the present study.

A number of studies have been made on the pest status, distribution, biology and control aspects of this shoot borer (Atuahene and Souto, 1983; Bennet and Grijpma, 1973; Gupta and Lamba, 1982; Kandasamy, 1969; Kirsten, 1988; Leugo, 1989; Mathur, 1967; Mishra, 1993; Roberts, 1965; 1968). More than 20 alternative host plants (Appendix1) have been reported (Ardikoesoema and Dilmy, 1956; Beeson, 1919; Brunck and Fabre, 1974; Fletcher, 1914; Ramaseshiah and Sankaran, 1994). Infestation of the leading shoots of mahogany

Table 1. Pests reported on mahogany

Insect	Country	Source
Ambleypelta cocophaga (Heteroptera : Coreidae)	Solomon Islands	Oliver,1992
Egchiretes nominus (Lepidoptera)	Belize, Honduras	Stevenson,1944, Chable,1967
Diaprepes abbreviatus (Coleoptera:Curculionidae)	Puerto Rico	Bauer, 1987
Dysercus longiclaris (Coleoptera:Curculionidae)	Malaysia	Streets,1962 , Ata and Ibrahim,1984
Catopyla dysorphnaea (Coleoptera:Curculionidae)	"	Brunck and Mallet,1993
Gyroptera robertsii (Eugyroptera robertsii)	"	"
Crossotarsus externe-dentatus (Coleoptera:scolitidae) *Platypus gerstaeckeri* (Coleoptera: scolitidae)	Fiji	Roberts,1977
Coptotermes sp. *Neotermes samoanus* *N. papua* *Procryptotermes* spp. (Isoptera)	Fiji, Sri Lanka, Solomon Islands, Belize	Oliver,1992 Stevenson,1940 Kamath *et al.*, 1993 Kamath *et al.*, 1995

(*S. macrophylla*) by *H. robusta* in West Java, and Indonesia has been reported by Suratmo(1976) and Suharti and Santoso (1990). Trees below 8 years (< 7m in height) of age were heavily infested and the intensity of damage decreased with the increase in age and height of trees. Close spacing (1m x 2m or closer) has been advocated to encourage height growth and thereby reduce the period of susceptibility to *H. robusta* (Suratmo, 1977). *H. robusta* infestion on mahogany has also been reported from the Philippines (Leugo,1989). The serious threat of this pest had been recognized long back and attempts have been made to evolve control measures through standardization of silvicultural, biological and chemical methods. Roberts (1965) reported that chemical control of *H. robusta* was impracticable in view of the continuous attack by this shoot borer. He also found that the biological control of this shoot borer using parasites was not possible because of the low rate of parasitisation.

Kirsten (1988) reported that control of the pest could be achieved with electrostatic application of the insecticide. In this method, the insecticide is applied only where it is needed, on the foliage and shoots.

Roberts (1968) described the biology of *H. robusta* in Nigeria. Though no control measures have been discussed, it was suggested that biological control offered better possibilities than insecticides. An entomogenous fungus, *Beauveria bassiana (Balsano)Vuillemin* has been isolated from dead larvae of *H. robusta* collected from Dehra Dun. Experiments in outdoor cages gave 80% mortality of the larvae when sprayed with an aqueous spore suspension of the fungus . It was concluded that the fungus is a promising pathogen for the biocontrol of this serious pest infesting Toona *ciliata* and Swietenia *macrophylla in* India (Mishra, 1993).

H. robusta is reported as a new host for the fungus *Beauveria tenella* (Delacroix) Siemaszko. This fungus has been isolated from diseased caterpillars.

2. MATERIALS AND METHODS

2.1. STUDY AREA

The field studies were carried out during 1994 -96 at Chelakkadavu, Vazhikadavu Range of Nilambur North Forest Division and at Mikamine, Punalur Range, Punalur Forest Division.

2.2. MONITORING OF THE PEST INCIDENCE

General survey on the shoot borer attack in various mahogany plantations of different age groups was made and study plots demarcated. The plots were laid in younger plantations (Table 2) as the pest incidence was greater in them. The incidence of shoot borer in younger plantations was compared with that in older trees. The study plot consisted of 100 plants which were marked along a transect passing across the plantation. Visual observations were made on the following parameters and the data recorded once in every month (a) the number of shoots on each marked plant (old/new/tender), (b) the number of shoots attacked by the borer (old/new/tender), and (c) the number of various stages of the borer (egg/larva/pupa) on the shoots. Also, various life stages of the borer were collected for laboratory rearing and recording the life cycle.

2.3 CONTROL MEASURES

Based on the information available in the literature, two insecticides, Dimethoate (Rogor 30EC) and Phosphamidon (Dimecron 85SL), were used in control trials against the borer, in a 2 year old plantation at Chachikkuzhi, Nilambur. Three concentrations of Rogor (0.01%, 0.25% 0.5%), and two concentrations(0.1% and0.25%) of Dimecron were field-tested. Ten borer-attacked plants were marked for each concentration and the number of infestation points on each of these plants, were counted.

Spot application of the chemical, at the entrance of the feeding tunnel, after removing the frass, was done and observations recorded at 24 h, 48 h and 72 h.

3. RESULTS AND DISCUSSION

3.1. LIFE CYCLE

The life cycle of *H. robusta* lasts for about 35-40 days. In the field, the borer population was found throughout the year on tender shoots of *S. macrophylla*. The generations overlap throughout the year. Oviposition occurs on the tender shoots and the neonate (young) larvae, on emergence, search out new locations for establishment. These larvae attempt to feed on different locations as was evidenced by the presence of resin spots on new shoots. These larvae finally enter fresh tender shoots. Inside the shoot, the larvae feed on the pith, usually downwards and clear off the faecal pellets outside through the entry hole. Some larvae were found to feed initially on the veins of leaves. In the absence of tender shoots, the larvae start feeding under the bark. On completion of the larval period inside the tunnel, the mature larvae pupate within a silken cocoon near the entry hole of the tunnel. The larval period lasts for about 15 to 20 days and pupal period, up to 10 days. On the first day of emergence , the adults mate and the females search for new tender shoots to lay their eggs. The eggs are laid singly on these shoots.

3.2. NATURAL ENEMIES

A number of parasites and pathogens have been reported on *Hypsipyla robusta* (Bennet and Grijpma,1973; Brunck and Mallet,1993; Kandasamy,1969; Ramaseshiah and Sankaran, 1994; Rao and Bennett, 1968 ; Wali Ur Rehman, 1993). During the present study a parasitic nematode, Hexamermis sp. (*Octomyomermis muspratti)* was found to attack and kill *H. robusta* larvae . This was collected from the body cavity of *Hypsipyla robusta* (Moore). However, the rate of parasitisation observed was very low. A mermithid nematode, *O. muspratti (Reesimermis muspratti*) had been reported earlier from North India (Gupta and Lamba, 1982).

3.3. POPULATION TREND

The field data generated for about 2 years indicated the relationship between availability of new shoots and borer incidence. At Chelakkadavu, the production of new shoots showed a declining trend (Fig.1) from November 1994(97%) to July 1995(23%). The monsoon rains during 1995-96 did not seem to have influenced the overall production of new tender shoots at this study plot. From July to September the rate of production of new shoots showed an increasing trend(23% in July to 48% in September). This seemed to remain in a stable state, with slight decline, till the end of the year. In the beginning, (during November to December 1994) the shoot borer population showed an increasing trend. It then declined till March 1995. Shoot borer population showed its first increase during March to May 1995. A second phase of increase in population of the borer occurred during July to September. It then remained stable with slight declining trend towards the end of the year (Fig.1). During 1995-96 period the lowest borer population was noted from February to March.

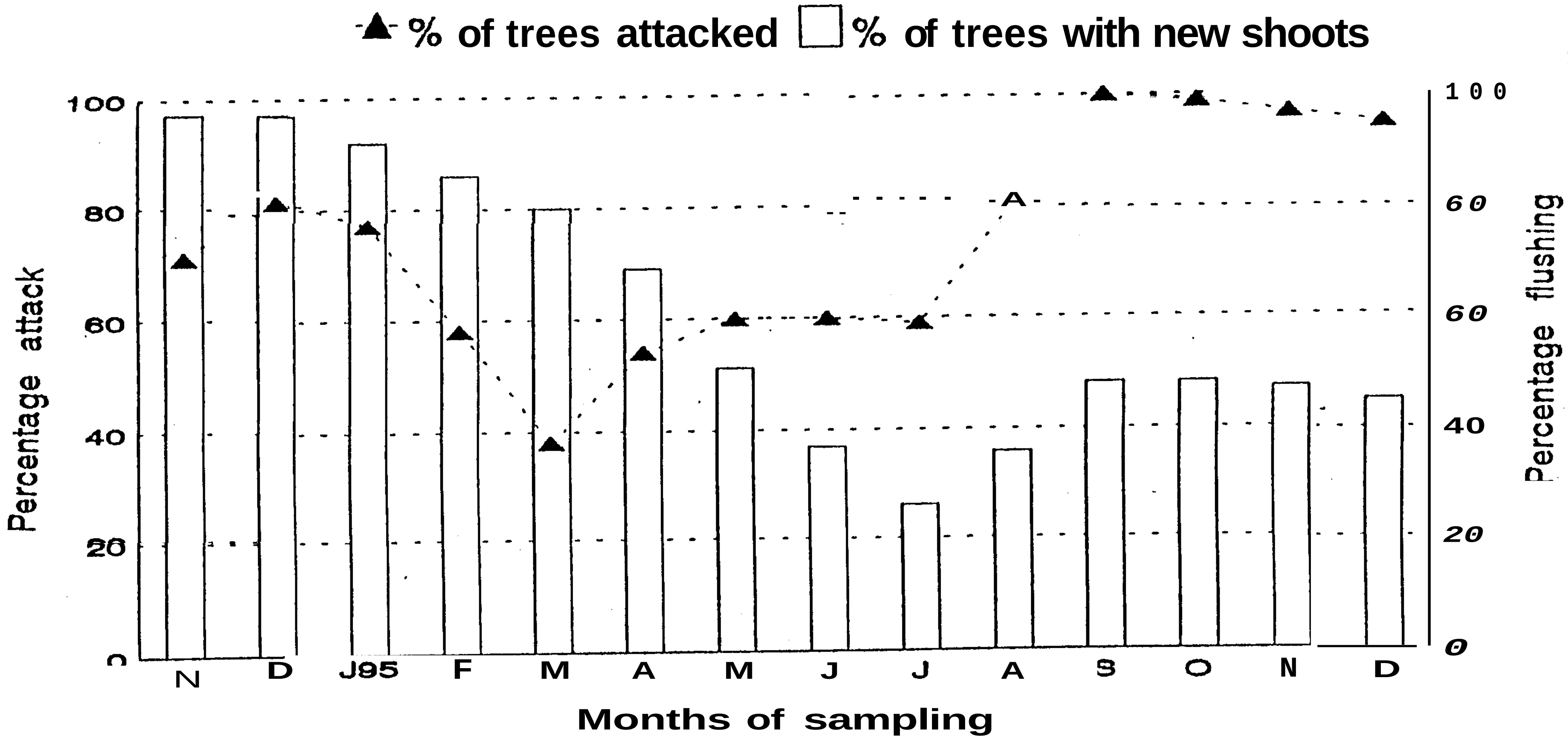

Fig.1. *Hypsiphyla* population at Chelakkadavu, Nilambur, as related to the flushing trend during 1994-95.

The population trend of *H. robusta* at Makamine, Punalur was also studied simultaneously with the study at Nilambur, during October 1994 to December 1995 and five months during 1996-97. Figure 2 depicts the trend in shoot formation and shoot-borer infestation. From November 1994 to December 1995 the shoot production fluctuated at three to four month's interval. The lowest shoot production was recorded in February 1995 and the highest in March 1995. If we consider the behaviour of the shoot borer, the lowest population was during October 1994 to February 1995. From March 1995 onwards the shoot borer population increased, with a peak in May 1995 and a second peak in August 1995. Though there were only two population peaks noticed during the study period, the population was at its maximum(80 to 90%) from April to December 1995. Observations indicate that population size of the shoot borer depends on availability of the fresh shoots.

From Chelakkadavu, Nilambur, during 1996-97 period data for only five months could be collected on shoot formation and infestation by the shoot borer. The data showed that the lowest flushing occurred during the month of June and the highest in July . The data also indicated that the shoot borer attack was the lowest in June and the highest in August . During 1996-97, from Mikamine, Punalur, data for five months on the shoot production and infestation showed that shoot production was the lowest in February and the highest in July. With regard to infestation by the borer, the lowest intensity was in June and highest in July and November.

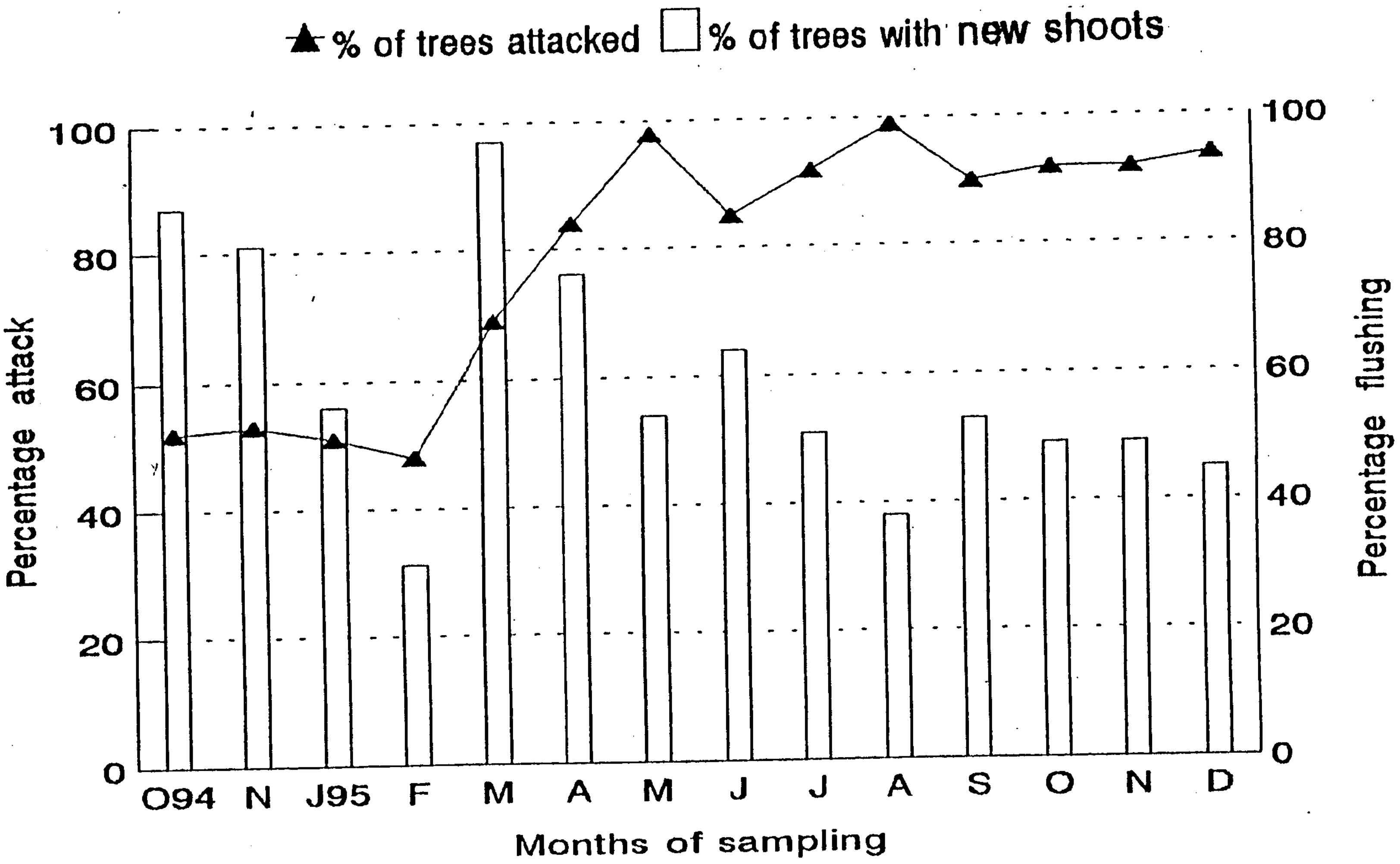

Fig.2. *Hypsiphyla robusta* population at Mikamine, Punalur, along with the flushing trend during 1994-95.

3.4 RELATIONSHIP BETWEEN AGE OF THE TREES AND BORER INCIDENCE

The status of borer infestation recorded from various plantations is given in Table 2. The data indicate that plantations below the age of 5 years were highly susceptible to infestation.

Table 2. *H. robusta* infestation in selected mahogany plantations

Year of planting	Age of Plantation (yr.)	Location	Name of forest Division	Infestation (%)
1995	1	Chackikuzhi	Nilambur	15
1994	2	Kottakkayam	Punalur	35
1994	2	Mukkalampad	Punalur	35
1993	3	Puthenpalam	Punalur	70
1993	3	Chelakkadavu	Nilambur	70
1993	3	Thodiyilkandam	Punalur	70
1992	4	Chanakkamone	Punalur	70
1992	4	Mikamine	Punalur	70
1991	5	Palakulam	Punalur	15

3.5 CHEMICAL CONTROL

Out of the two concentrations of Phosphamidon (Dimecron 85 SL), 0.1% concentration resulted in 72.7% and 100% mortality by 24 h and 48 h of application, respectively. With 0.25% concentration of the insecticide 100% mortality occurred after 24 h.

Dimethoate (Rogor 30 EC), 0.01 % concentrate solution gave only 28.6% mortality by 72 h. When higher concentration of (0.25%) was used mortality rate was 27.3%, 81.3% and 90.9% by 24 h, 48 h and 72 h respectively. When a concentration of 0.5% of the insecticide was used 72.7% and 100% mortality was observed by 24 h and 48 h of application, respectively.

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APPENDIX I

Alternative host plants of *Hypsipyla robusta* Moore (Lepidoptera: Pyralidae : Phycitinae)

1. *Canarium schueinfurthii*
2. *Carapa guianensis*
3. *Cedrela australis*
4. *C. mexicana*
5. *C. multijuga*
6. *C. odorata*
7. *C.sureni*
8. *C. toona*
9. *Chukrasia tabularis*
10. *C. velutina*
11. *Entandrophragma angolense*
12. *E. utile*
13. *Khaya anthotheca*
14. *K. ivorensis*
15. *Soymida febrifuga*
16. *Swietenia candollei*
17. *S. macrophylla* King
18. *S. mahagoni* (L.),Jacq.
19. *Toona ciliata*
20. *Xylocarpus guianensis*
21. *X. moluccensis*