

## THE EFFECTIVENESS OF *TOONA SINENSIS* (MELIACEAE) AS INSECT REPELLENT

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**NORAINI, M.T., NORHAYATI, I. & JAMILAH, M.S. 1996. The effectiveness of *Toona sinensis* (Meliaceae) as insect repellent.** An experiment was conducted over a period of six weeks, to observe the effectiveness of *Toona sinensis* as insect repellent. Three other tree species from the same family (Meliaceae), namely, *Toona sureni*, *Chukrasia tabularis* and *Swietenia macrophylla* were used as test plants, as most meliaceous trees are susceptible to attacks by shoot borers. The percentage of leaf damage of test plants at six different distances from *Toona sinensis* was used as a measure of effectiveness of the latter in repelling insect pests. It was found that *Toona sinensis* was effective in controlling pest attacks, the more so the nearer this species was to the test plants. *Swietenia macrophylla* was least susceptible to pest attacks, *Chukrasia tabularis*, more susceptible and *Toona sureni*, the most susceptible. *Toona sinensis* placed among a mixture of the three test plants was effective in controlling pest attacks.

Key words: *Toona* - Meliaceae - insect repellent - effective pest control - shoot borers

**NORAINI, M. T., NORHAYATI, I. & JAMILAH, M.S. 1996. Keberkesanan *Toona sinensis* (Meliaceae) sebagai pencegah serangga.** Satu kajian telah dijalankan selama enam minggu, untuk mengkaji keberkesanan *Toona sinensis* sebagai pencegah serangga. Tiga lagi spesies pokok dari famili yang sama (Meliaceae), iaitu *Toona sureni*, *Chukrasia tabularis* dan *Swietenia macrophylla* telah digunakan sebagai pokok ujian, kerana kebanyakan pokok dari famili ini adalah rentan kepada penebuk pucuk. Peratus kerosakan daun pada pokok ujian yang diletak di enam jarak yang berlainan dari *Toona sinensis* telah digunakan untuk menilai keberkesanan spesies ini untuk mencegah serangga perosak. Didapati bahawa *Toona sinensis* boleh mengawal serangan perosak dengan berkesan, khususnya apabila pokok ini terletak lebih dekat dengan pokok ujian. *Swietenia macrophylla* kurang rentan sekali, *Chukrasia tabularis* lebih rentan, sedangkan *Toona sureni* paling rentan. *Toona sinensis* apabila diletak di antara campuran ketiga-tiga pokok ujian adalah berkesan dalam mengawal serangan perosak.

## Introduction

The family Meliaceae has many species that are valued for their good quality timber, for example *Toona sinensis* (surian bawang), *Toona sureni* (surian wangi), *Chukrasia tabularis* (surian batu) and *Swietenia macrophylla* (mahogany). These species have wide pan-tropical distributions, and occur in diverse habitats in the tropical rain forests, from mangrove forests, hill dipterocarp and lower montane forests (Metcalf & Chalk 1950, Pennington & Styles 1975, Mabberley & Pannell 1989). *Toona sinensis* and *Toona sureni* are indigenous species in Malaysia and have been promoted (Noraini *et al.* 1992) as commercially important for reforestation, as ornamentals (Noraini 1992) and for stabilising steep slopes (Barker *et al.* 1994).

The most important commercial value of meliaceous species is timber for furniture, boat building, crafts and musical instruments (Corner 1988). *Toona* spp., in particular, are fast growing, with a girth growth rate of about 5 cm per year (personal observation) compared to most dipterocarp trees which attain a growth rate of 2.8 cm per year (Foxworthy 1927). *Toona* can reach 13 m in 13 y, with 68 cm girth, while some can attain 149 cm girth after 30 y (Gamble 1972).

*Toona* spp. are pioneer trees, often attacked by insect pests, which result in the formation of many lateral branches, and dwarfing of trees. This makes the trees less attractive for sawn timber. Some of the insect pests include *Margina robusta* (Phycitidae) (Gamble 1972), and the shoot borer, *Hypsipyla robusta* (Lepidoptera: Pyradidae) (Styles & Khosla 1976). *Toona* seedlings and saplings are most susceptible to attacks by *Hypsipyla* sp. (Grijpma 1976).

*Toona sinensis* is locally known as surian bawang or suntang puteh (Watson 1928) while its synonym is *Cedrela serrata*. Crushed bark and leaves, as well as seeds of this species emit a strong odour resembling garlic, originating from phenolic compounds, believed to repel insect pests. It was reported that secondary compounds with strong odours can be poisonous to certain pests (Swain 1977, Mong & Sudderuddin 1978).

The study was conducted to determine the effectiveness of *Toona sinensis* in controlling insect attacks on the four meliaceous species, used as test plants. The experiments were conducted near the Green House Complex of Universiti Kebangsaan Malaysia, Bāngi, from August until December 1993.

## Materials and methods

In this study, 6-month-old seedlings, about 20 cm tall and grown in the greenhouse, were used. These seedlings were transplanted into perforated black nursery polybags (20 × 30 cm) three quarter full of a mixture of soil, sand and padi husks (ratio 1:1:1). When the transplanted seedlings were ready, they were brought to an open space and placed 10 cm apart on wooden planks, about 40 cm above ground.

The test species, *Toona sureni*, *Chukrasia tabularis* and *Swietenia macrophylla* were arranged in separate rows, in a cross intersection on the wooden planks. The putative insect repellent species, *Toona sinensis*, was placed in the centre. As a control to the experiment, *Toona sinensis* was replaced with the same species as the test species. Each section of the cross contained six test trees, placed 25 cm apart. A combination of the three test species was also prepared.

The above experiment was conducted using three replicates.

### Data sampling

Data taken immediately after placing the test plants in the field were considered as data for week 0. During sampling, the percentage of damage caused by pests was observed, and given the following arbitrary values :

Value	Corresponding percentage damage
0	0
1	1 - 10
2	10 - 25
3	25 - 50
4	50 - 70
5	> 75

### Data analysis

The data were analysed using the Statistical Analysis System for values of mean differences between species and differences between experiments and control.

## Results and discussion

The results of this study are summarised in the graphs (Figures 1- 3), which show the levels of damage in the test plants at six positions (from 10 cm - 60 cm) away from *Toona sinensis*, after 1, 5, and 10 weeks.

A week after the experiment was set up (Figure 1), most test plants showed low damage values (between 0.5 to 2.0). Test plants that were nearest to *Toona sinensis* were protected for longer periods from insect attacks. The first species to be attacked was *Toona sureni*. By the fifth week (Figure 2), all test plants showed higher damage values (0.5-2.5), those nearest to *Toona sinensis* with less visible attacks. At the end of the experiment, at week 10 (Figure 3), damage values peaked to 3.5 for test plants at greatest distances away from *Toona sinensis*.

When the damage to the leaves of test plants is expressed as a percentage, it was noted that *Toona sureni* showed damage exceeding 75%, *Chukrasia tabularis*

between 50 and 75 %, and *Swietenia macrophylla*, between 10 and 25 %. Thus the leaves of *Toona sureni* were most susceptible to insect attacks, probably because these were thinner and softer than the rest. Furthermore shoots of all test plants were badly attacked compared to older leaves.

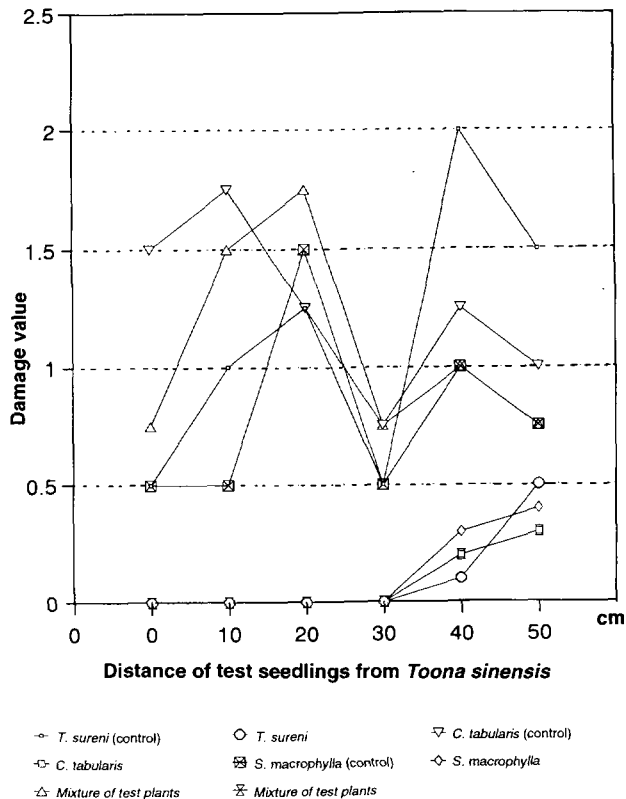
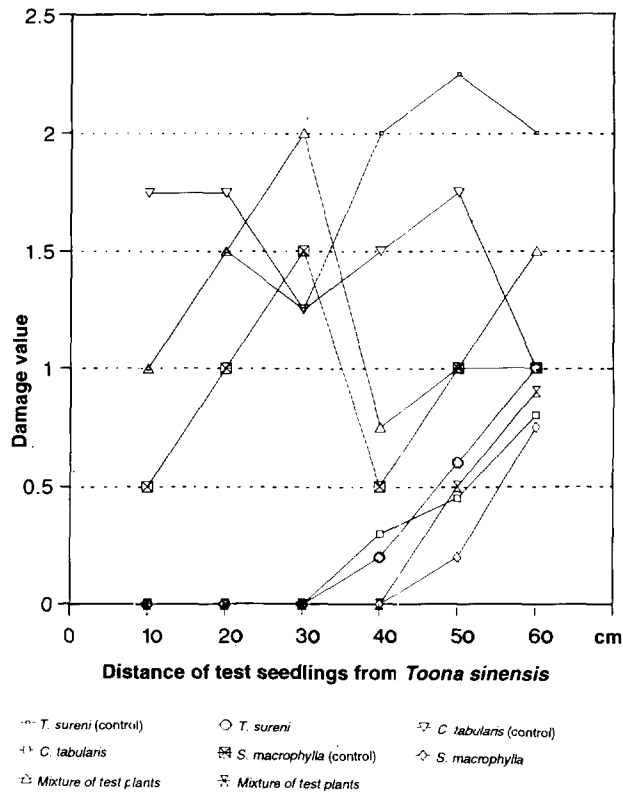


Figure 1. Damage of test seedlings at various distances from *Toona sinensis* seedlings (week 1)

Various pests were seen attacking the test plants. There were two species of grasshoppers, *Xenocantops humilis* and *Caryanda diminuta* (Acrididae), and a snail, *Succinea* sp. (Mollusca) that attacked the leaves and stems of most test plants. Others include insects (Hemiptera, Homoptera, Coccoidea) that damaged stems, and caused the death of seedlings.

It was found that the level of damage of test plants was significantly reduced ( $p > 0.05$ ) when *Toona sinensis* was used as the repellent species. Based on Duncan's *t*-test, it was proven that *Toona sureni* was the most susceptible to insect pests, and *Swietenia macrophylla* least susceptible. A combination of the three test species showed intermediate susceptibility. Based on this result, it is probable that multiple species planting of *Toona* spp. and *Chukrasia tabularis* in the field may reduce insect attacks. *Swietenia macrophylla* is probably a better candidate for monoculture planting.



**Figure 2.** Damage of test seedlings at various distances from *Toona sinensis* seedlings (week 5)

Planting diversity tends to reduce insect pest damage. In this study, the use of aromatic species as a repellent, showed a potential in reducing or eliminating the use of pesticides. The strong garlic odour emitted by *Toona sinensis* was effective in controlling pest attacks at the specific time of study, on test plants placed at specific distances from this species (*Toona sinensis*).

Earlier studies on *Toona* spp. (Noraini *et al.* 1992, Edmonds 1993), revealed the presence of several compounds such as alkaloids, coumarins and flavonoids in the leaves and shoot tips of *Toona*. Oxalic acid is present in the bark while oils are found in *Toona* fruits. Compounds, for example deoxycedrellone, proanthocyanidins, cedrellone, cedrellone iodoacetate and leucocyanidins are found in the heartwood, while siderin and sesquiterpenoids are present in other woody parts. Degraded triterpenes, known as limonoids, are compounds that characterise the family Meliaceae, but these are not present in *Toona sinensis*, while in *Toona sureni*, there exists a primitive picrorianin limonoid known as surenin.

Related to this, it was observed that some secondary aromatic compounds are strong smelling while others can kill insects that eat them (Swain 1977, Mong & Sudderuddin 1978). It was believed that the larvae of *Hypsipyla grandella* did not

bore the trunk of *Toona sinensis* but bored the trunks of other trees, for example *Aucaumea* sp. (1.24 cm), *Khaya* sp. (9.68 cm), *Swietenia* sp. (19.26 cm) and *Cedrela* (19.68 cm) for food. The mortality of *Hypsipyla grandella* larvae that attacked *Toona sinensis* was high (Grijpma & Gara 1970).

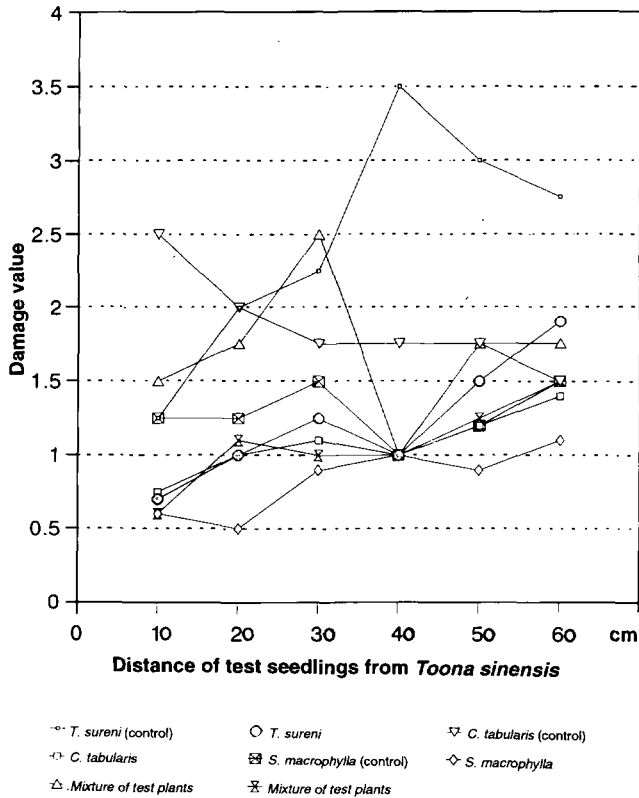


Figure 3. Damage of test seedlings at various distances from *Toona sinensis* seedlings (week 10)

The study showed that the presence of *Toona sinensis* was effective in controlling insect attacks on the leaves of the test plants, and this is probably due to the presence in the leaves of aromatic compounds which can act as repellants. The most common pest was insect (Lepidoptera) larvae. However, the relationship between the effectiveness of *Toona sinensis* (in controlling damage) and its distance from the test plants varied with species.

Towards the later part of the study, several test plants close to *Toona sinensis* were attacked by insect pests. During the last (10th) week, even *Toona sinensis* was attacked. It was also found that insect population increased during the wet season, thus exposing the leaves to greater danger of being attacked.

## Conclusion

Meliaceous tree seedlings placed near seedlings of *Toona sinensis* were less damaged by insects than seedlings of the same species placed at varying distances away. The seedlings of *Toona sureni* was most susceptible to insect damage, followed by *Chukrasia tabularis* and *Swietenia macrophylla*. However, when all three species are placed near *Toona sinensis*, the damage was intermediate. This finding has important implication in silviculture and it is suggested that the planting of several species of meliaceous trees will reduce the level of insect damage thereby reducing the need to use pesticides. This will also reduce costs and probably help promote sustainable forest management.

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