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THE SCALE INSECTS, WHITEFLIES, APHIDS AND PSYLLIDS OF THE NEEM TREE, *AZADIRACHTA INDICA* (MELIACEAE).

ABSTRACT

THE SCALE INSECTS, WHITEFLIES, APHIDS AND PSYLLIDS OF THE NEEM TREE, *AZADIRACHTA INDICA* (MELIACEAE).

The neem tree, *Azadirachta indica* (Meliaceae), is attacked by numerous scale insect species, mainly diaspidids, coccids and pseudococcids, as well as a few species belonging to other families in the Sternorrhyncha. *Aonidiella orientalis* (Newstead) is the most important pest of neem; others such as *Pinnaspis strachani* (Cooley), *Chrysomphalus aonidium* (L.) and *Pulvinaria jacksoni* (Newstead) are minor pests of local importance. Water stress or unsuitable soil conditions in Africa and elsewhere may reduce the resistance of the trees and, therefore, increase the probability of outbreaks. Most scale insects attacking neem are more or less polyphagous species. The closely-related chinaberry tree, *Melia azedarach*, is also attacked by many scale insect species, suggesting that neither of these closely related plants can protect themselves against those scale insects species which can either avoid the tissues containing the active ingredients or are naturally resistant to them.

Key words: Indian lilac, Persian lilac, azadirachtin, antifeedant, Africa, Asia, South Pacific, tropical America, *Oryzaephilus surinamensis*. damage, pest status, *Oecophylla smaragdina*, Aleyrodoidea, Psylloidea, Aphidoidea.

INTRODUCTION

The Indian lilac or neem tree, *Azadirachta indica* (Meliaceae), has attracted much attention from research workers during the last 20-30 years, mainly because it contains a highly active secondary plant chemical, the tetranortriterpenoid azadirachtin, which has insect antifeedant, growth disrupting and sterilising properties, as well as other effects on insects. Based on extracts of neem seed kernels, various pesticides have been developed, suitable for integrated pest management in tropical and temperate climates.

It might have been expected that only a few insect species would attack plants which contain such highly effective insecticidal ingredients. However, with regard to the neem tree, numerous insects have been recorded (Boa, 1995; Schmutterer, 1995; Tewari, 1992) although most cause no obvious damage. The number of Coccoidea recorded from neem is quite high, about 40 species, but the numbers of other Sternorrhyncha is much lower, with few whitefly species and even fewer aphids and psyllids.

The most important species of the various superfamilies in the Sternorrhyncha attacking *A. indica* will be discussed below.

Table 1. Armoured scales (Diaspididae) infesting neem trees.

Diaspidid species	Country
<i>Aspidiotus destructor</i> Signoret	India
<i>Aonidiella orientalis</i> (Newstead)	Worldwide*
<i>A. aurantii</i> (Maskell)	Australia*
<i>A. inornata</i> McKenzie	Malaysia*
<i>Chrysomphalus aonidum</i> (L.)	Nicaragua*, Kenya*, Madagascar*, Papua New Guinea*
<i>C. dictyospermi</i> (Morgan)	Papua New Guinea*
<i>Selenaspis articulatus</i> (Morgan)	Senegal*, Benin*, Papua New Guinea*, Fiji*
<i>Hemiberlesia lataniae</i> (Signoret)	Kenya*, Fiji*
<i>H. palmae</i> (Cockerell)	Papua New Guinea*
<i>Parlatoria crypta</i> McKenzie	India*†, Niger*, Nigeria
<i>P. proteus</i> (Curtis)	Madagascar*
<i>P. camelliae</i> (Comstock)	India
<i>P. cinerea</i> Hadden	India
<i>P. citri</i> MacKenzie	India
<i>P. orientalis</i> Rao	India
<i>Fiorinia coronata</i> Williams & Watson	India*
<i>Lepidosaphes meliae</i> Green	Senegal*, Kenya*, Cameroon
<i>L. tapleyi</i> Williams	Malaysia*
<i>L. karkarica</i> Williams & Watson	Malaysia*
<i>Pinnaspis strachani</i> (Cooley)	Worldwide*
<i>Pseudaulacaspis cockerelli</i> (Cooley)	Malaysia*

*collected by the author. †recorded as *P. ?morrisoni* McKenzie (synonymised with *P. crypta* McKenzie by Danzig (1993)).

SCALE INSECTS (COCCOIDEA).

The dominant family of scale insects on *A. indica* is the Diaspididae (Table 1). At present, 22 species have been recorded, most of them from Asia (the source of origin of the neem tree), but with a few from the South Pacific, Africa and from tropical America. A few diaspidid species have an almost worldwide distribution on neem, e.g., *Pinnaspis strachani* (Cooley).

Aonidiella orientalis (Newstead) (Fig. 1) is the most serious pest of neem and outbreaks have been observed in parts of Africa, especially in countries around Lake Chad (Niger, Nigeria and Cameroon). The main reason is thought to be water stress. Heavy infestations on the leaves and shoots result in dieback, even sometimes in the death of heavily infested trees. In large areas of East Africa and Asia, *A. orientalis* is common but almost never reaches pest populations, most probably because it is well controlled by natural enemies, such as coccinellids and parasitoids.

P. strachani and *Chrysomphalus aonidum* (L.) are widespread minor pests of neem, although they occasionally cause local outbreaks which lead to leaf



Fig. 1. *Aonidiella orientalis* on the upper surface of leaflets of *Azadirachta indica*.

shedding and dieback of branches. In southwestern Madagascar, it was considered that the unfavourable limestone soil conditions may have been the main contributory reason for some damage caused by *C. aonidum*.

Five species of *Parlatoria* attack neem in India (*P. camelliae* Comstock, *P. orientalis* Rao, *P. crypta* McKenzie (as *P. morrisoni* McKenzie), *P. cinerea* Hadden and *P. citri* McKenzie (Suresh, 1995)), while *Parlatoria crypta* McKenzie is very common in parts of sub-sahelian Africa, such as Niger. Large populations of the latter species were seen on the upper surface of leaflets but the damage caused was apparently limited. The same applied to *Lepidosaphes tapleyi* Williams. Both *P. crypta* and *L. tapleyi* were also common on mango (*Mangifera indica*).

Altogether 13 species of soft scales (Coccidae) have been recorded attacking *A. indica* (Table 2). From the economic point of view, *Pulvinarisca jacksoni* (Newstead) (Africa, India) and *Megapulvinaria maxima* (Green)

(India) seem to be important. Local outbreaks of these species have been recorded several times and these two coccids, along with the occasional *Chloropulvinaria psidii* (Maskell), produce large amounts of honeydew which quickly become covered by sooty mould.

Four species of *Ceroplastes* have been recorded from Asia (mainly India) but they seem to play no role as pests. *Milviscutulus mangiferae* (Green) was collected in Thailand and in Papua New Guinea where, in the Markham Valley, it attacked the youngest shoot-tip leaves, where it was attended by the weaver ant, *Oecophylla smaragdina* (Fabricius), in its leaf nests.

Table 2. Soft scales (Coccidae) infesting neem trees

Coccid species	Country
<i>Pulvinarisca jacksoni</i> (Newstead)	Niger*, Togo*, India*
<i>Megapulvinaria maxima</i> (Green)	India*
<i>Chloropulvinaria psidii</i> Maskell	India, Togo*
<i>Pulvinaria aligarensis</i> Avasthi & Shafee.	India
<i>Vinsonia stellifera</i> (Westwood)	Dominican Republic*, Philippines*, Benin*
<i>Ceroplastes floridensis</i> Comstock	India, Madagascar*, Kenya*
<i>C. ceriferus</i> (Fabricius)	India
<i>C. pseudoceriferus</i> Green	India*
<i>Ceroplastes</i> sp.	Papua New Guinea*
<i>Milviscutulus mangiferae</i> (Green)	Papua New Guinea*, Thailand*
<i>Coccus hesperidum</i> L.	Madagascar*, Senegal*
<i>Coccus</i> sp.	India
<i>Parasaissetia nigra</i> (Nietner)	Kenya*, Malaysia*

*collected by the author

Only five species of mealybugs (Pseudococcidae) have been collected on neem trees, some in Asia, others in Africa (Table 3). In addition, *Kerria lacca* (Kerr) (Lacciferidae) attacks neem in India (Tewari, 1992) while, a few years ago, the author found an asterolecaniid (probably a *Planchonia* sp.) infesting petioles near Mombasa, Kenya.

WHITEFLIES, APHIDS AND PSYLLIDS

Little can be said regarding the occurrence of whiteflies, aphids and psyllids on neem trees but the four species of whiteflies recorded are listed in Table 4. These include the well-known citrus pest *Aleurotrixus floccosus* (Maskell) which was collected on Gran Canaria, Canary Islands; a small

colony of *Aleurocanthus woglumi* Ashby, also a widespread pest of citrus, in Melaka, Malaysia, and a few specimens of an *Aleuroplatus* sp. in Toliara, southwestern Madagascar.

Two species of aphids, namely *Aphis spiraeicola* Patch and *A. gossypii* Glover, have been recorded on seedlings and young shoots and leaves, mainly from the Caribbean. However, the colonies were destroyed by coccinellids within a few days and it seems unlikely that aphids can utilise neem for a longer period.

Table 3. Mealybugs (Pseudococcidae) infesting neem trees

Pseudococcid species	Country
? <i>Pseudococcus gilbertensis</i> Beardsley	India
<i>Paracoccus</i> sp.	India*
<i>Rastrococcus</i> ? <i>biggeri</i> Williams & Watson	Malaysia*
<i>Ferrisia virgata</i> (Cockerell)	Senegal*, Ghana*
<i>Maconellicoccus hirsutus</i> (Green)	Burkina Faso, Cameroon

*collected by the author

Table 4. Whiteflies (Aleyrodidae) infesting neem trees.

Aleyrodid species	Country
<i>Dialeurodes armatus</i> David & Subramaniam	India
<i>Aleurocanthus woglumi</i> Ashby	Malaysia*
<i>Aleuroplatus</i> sp.	Madagascar*
<i>Aleurothrixus floccosus</i> (Maskell)	Spain (Canary Is.)

*collected by the author

The psyllid *Diaphorina aegyptiaca* Puton seems to be the only species of jumping lice recorded from neem (India) (Boa, 1995). Schmutterer (1998) reported that females of the leucaena psyllid, *Heteropsylla cubana* (Crawford), laid eggs on the young shoots and leaves but the first-instar nymphs could not moult to the next instar. The same applied to the spiralling whitefly, *Aleurodicus dispersus* Russel, in Senegal.

The few species of whiteflies, aphids and psyllids found on *A. indica* suggest that this plant is, in general, an unsuitable host for these groups of sternorrhynchid insects.

It is difficult to answer this question satisfactorily. No trials have been carried out to assess the LC_{50} values using pure azadirachtin and scale insects. With aphids, very obvious differences regarding susceptibility were found, ranging from 3ppm to >150ppm (Feng & Isman, 1995). The silvianid beetle, *Oryzaephilus surinamensis* (L.), a well-known pest of stored products, can breed successfully in neem seed kernels that contain the highest concentration of azadirachtin on the neem tree.

One reason for the ability of scale insect species to live on neem could also be that they do not feed on plant tissues containing the active ingredients. However, Ossiewatsch (1999) showed that azadirachtin was translocated in the phloem of neem-treated cabbage plants and that the triterpenoid was also detected in the honeydew of the cabbage aphid.

There seem to be no scale insect species confined to neem alone. Most of the recorded species are more or less polyphagous, attacking a wide range of tropical plants from different families. Rather few, little-known species with a narrow host range (for instance, *Fiorinia coronata* Williams & Watson and *Lepidosaphes karkarica* Williams & Watson) have been recorded.

A close relative of the neem tree, the chinaberry tree or Persian lilac, *Melia azedarach*, contains active principles in its seed kernels which resemble those of *A. indica*. Chinaberry is also attacked by an array of scale insects (Kozár, 1992), some of which occur on neem, others not. *Pseudaulacaspis pentagona* (Targioni Tozzetti), for instance, is a pest of *M. azedarach* in the Mediterranean and in the South Pacific but has not been recorded on *A. indica*. From the above discussion, it would appear that the insecticidal and other active ingredients found in neem and chinaberry do not protect these trees against many scale insect species, which appear to be either resistant to the active ingredient or are able to avoid tissues with the active ingredients, whereas these chemicals can be rather effective against other sternorrhynchid insects, such as aphids, whiteflies and psyllids.

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