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Introduction into New Caledonia of two hispine phytophages of lantana : *Octotoma scabripennis* and *Uroplata girardi* (Coleoptera, Chrysomelidae)

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ABSTRACT

After a brief summary of the biological control agents introduced against lantana (*Lantana camara* L., Verbenaceae) in the Pacific Islands and Australia, we examine the introductions into New Caledonia, before 1977, of insects that are phytophages of this shrub. The most effective species seemed to be *Ophiomyia lantana* (Froggatt) (Agromyzidae) and *Teleonemia scrupulosa* Stål (Tingidae). However, it was concluded that addition agents were required to limit the spread of lantana and reduce the infestations in areas already invaded.

To complement their action two Chrysomelidae Hispinae, viz. one from Mexico (*Octotoma scabripennis* Guérin-Méneville) and the other from Brazil (*Uroplata girardi* Pic), were imported into New Caledonia in 1977, using strains reared by the CSIRO in Australia. Six years later, these lantana-infesting hispines seemed to be well established on the island. *U. girardi* is the most frequently collected species and has had a significant impact on the stands of this plant.

KEY WORDS: Biological control, *Lantana, Octotoma scabripennis, Uroplata girardi,* New Caledonia.

RÉSUMÉ

Après un bref rappel des essais de lutte biologique entrepris contre la multiplication des plants de lantana (*Lantana camara* L., Verbenaceae) dans les îles du Pacifique et en Australie, les auteurs font le point sur les introductions d'insectes déprédateurs de cet arbuste réalisées en Nouvelle-Calédonie avant 1977. Les meilleurs auxiliaires semblaient être *Ophiomyia lantana* (Froggatt) (Agromyzidae) et *Teleonemia scrupulosa* Stål (Tingidae), mais leur rôle était jugé insuffisant, ces insectes étant loin de parvenir à limiter l'extension des zones envahies.

Pour compléter cette action, deux Chrysomelidae Hispinae originaires l'une du Mexique (*Octotoma scabripennis* Guérin-Méneville), l'autre du Brésil (*Uroplata girardi* Pic) ont été importées dans le Territoire au cours de l'année 1977, à partir de souches multipliées en Australie par le CSIRO. Six ans plus tard, ces hispines inféodées au lantana paraissent bien établies dans l'île. *U. girardi* est plus fréquemment récolté et a un impact net sur les peuplements de la plante.

MOTS CLÉS : Lutte biologique, *Lantana, Octotoma scabripennis, Uroplata girardi,* Nouvelle-Calédonie.

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1. INTRODUCTION

Lantana (*Lantana camara* L., Verbenaceae) is an ornamental plant of American origin (from the south of the United States to Argentina). Its growth is reduced in winter in areas within the temperate zone. Several cultivars of this shrub were introduced into other tropical regions of the world : Africa, Madagascar, India, Australia, Asia and to most of the Pacific islands where they proliferated by roadsides, in pastures, valleys and edges of forests.

In New Caledonia lantana grows well on open grazing grounds of the western coast, where it constitutes a major disadvantage to cattle breeders. It also prevents reforestation in costal areas.

In its country of origin lantana does not pose special problems, because plants are scattered and seedlings are uncommon. Plants are subjected to permanent competition with other plants that are adapted equally to the environmental conditions in which lantana grows. On the other hand, lantana serves as a host to a whole range of herbivores. Exploratory studies in South America have shown that at least 345 species of insects belonging to 8 different orders and 6 acarian species live at the expense of this shrub (FLECHTMANN & HARLEY, 1974; WINDER & HARLEY, 1983). The cultivars of lantana are very variable and the same insect species may show a preference for one cultivar while rejecting others as suitable hosts.

The suppression of lantana with the aid of herbicides is possible, but this is an operation which is still difficult and too costly in the majority of cases. Biological control using insects has been used since the beginning of the century in an attempt to limit the spread of lantana. These insects were collected within the native range of this verbenaceous plant. Research into pathogenic fungi has also been made.

2. A SHORT HISTORY OF THE ATTEMPTS AT BIOLOGICAL CONTROL OF LANTANA IN THE PACIFIC ISLANDS AND AUSTRALIA

2.1. Biological control of lantana using phytophagous insects started on the Hawaiian islands in 1902 when KOEBELE brought more than 20 species from Mexico. Eight of these taxa established and control of the plant was realised in the driest zones of Hawaii (KRAUSS, 1962).

In 1952 lantana was again a problem in Hawaii and it was noticed that there were three distinct strains of *L. camara* with only one of these causing the main infestations. In an attempt to achieve satisfactory biological control other insects were imported and subsequently 15 species became established on these islands (HARLEY, 1969).

For many years, Hawaii served as the centre of distribution of phytophagous insects for biological control of lantana for many countries.

2.2. In 1948 and 1949, the Marianas, the Marshall and the Caroline Islands imported four insects from Hawaii, but only two of these established *Teleonemia scrupulosa* Stål (Heteroptera, Tingidae) and *Epinotia lantanae* (Busck) (Lepidoptera, Tortricidae) (GARDNER, 1958, *in* RAO *et al.*, 1971).

3.2. Biological control agents of lantana established before the introduction of Hispines

Only two insects were introduced with success, viz. *Ophiomyia lantanae* and *Teleonemia scrupulosa* (Cohic, 1952). An attempt at importing *Syngamia haemorrhoidalis* Guénée (Lepidoptera, Pyralidae) from Hawaii failed, since adults and pupae died on the way (Szent-Ivany, 1964, *in* Rao *et al.*, 1971).

A lepidoptera *Neogalea esula* (Druce) (Noctuidae, Acronictinae) of American origin, imported to Hawaii, Australia and Norfolk Island (situated between New Zealand and New Caledonia), seems to have arrived in Caledonia without human intervention, being collected only once in the Pass of Amieu (A. Delobel, February 1977, in Holloway, 1979).

Two other phytophages, probably present in the Territory before the arrival of the plant, became adapted to lantana : a lepidoptera *Hypena laceratalis* Walker (Noctuidae, Hypeninae), spread in the whole eastern tropical region (Holloway, 1979) and a phytophagous pantropical acarian *Brevipalpus phoenicis* (Geijskes) (Tenuipalpidae), collected in the Pass of Amieu (J. Gutierrez, November 28, 1978).

• Caterpillars of the two noctuids living on lantana eat leaves, but only *Hypena laceratalis* is abundant on the island and has a small effect on the plant.

• *Brevipalpus phoenicis* pierces cells of the leaf parenchyma and empties their content, which causes a very slight discoloration of leaves, but we have never observed a rapid multiplication capable of endangering lantanas.

• *Ophiomyia lantanae* was introduced from Hawaii in 1911 after a mission financed by a public subscription (Cohic, 1952). This agromyzid easily established itself in the region of Noumea and spread in the whole island where it is found nowadays everywhere.

Ophiomyia larvae, known by the name "maggots of lantana berries", eat the pericarp of fruits which are still green. The fly lays eggs in the fleshy part of green berries, larvae feed on them without reaching the cavities surrounding the embryo and the pupation takes place in ripe berries. The majority of berries dry out and fruits do not become detached from their peduncle. The presence of the maggot brings about the withering of a significant percentage of embryos (Cilliers, 1987).

The adult is a small fly 2 mm long which has a shining black body and wings with black veins. An ecological study of this species, made on the southern coast of Natal (South Africa) in a climate slightly cooler than that of New Caledonia, shows that one generation lasts about 21 days and that there are from 14 to 16 generations per year (Cilliers, 1987). More than 50% of ripe berries are susceptible to infestation and *O. lantanae* attacks all the varieties of lantana. But, despite the high level of its populations, this agromyzid plays only a secondary role in the control of these plants, compared with other species (Harley, 1973).

• *Teleonemia scrupulosa* was imported in 1936 from a strain in the Fiji Islands originating from Hawaii. It became acclimatised in the whole island. From there it was even introduced into the Loyalty Islands (Lifu) and into Vanuatu (Cohic, 1952). Regarded as one of the more successful biological control agents, *T. scrupulosa* has a preference for some cultivars : it attacks chiefly the varieties with red flowers and tends to neglect the pink variety (Harley & Kassulke, 1971; Winder & Harley, 1983). On the other hand, its populations are less numerous in moist or cooler regions.

In New Caledonia its impact on lantana is more pronounced in the dry zones of Ouaco and Bouloupari than on the eastern coast. The relative abundance of the pink variety in the whole Territory is perhaps not unconnected with the presence of this tingid.

The adult of light brown colour is, on an average, from 3.5 to 4 mm in lenght and hardly more than 1 mm in width. The anterior wings and the pronotum are slightly pubescent. Nymphs and imagos live on the lower side of the leaf which they pierce in order to feed on it. They cause disorders of growth and the appearance of whitish spots. Leaves can turn yellow and dry completely. Adults attack preferably young leaves, flowers and young stems.

Numerous details of the biology of this species were collected by HARLEY & KASSULKE (1971), HARLEY *et al.* (1979), CILLIERS (1987) in Australia and South Africa. In these regions *T. scrupulosa* becomes inactive when the mean temperature drops below 16°C, but in New Caledonia the climate enables it to stay active all year round.

4. INTRODUCTION OF THE HISPINAE

4.1. THE INTRODUCED SPECIES

Since 1976 among the insects available in Australia the CSIRO has proposed the introduction of two species which can complement the action of *Ophiomyia lantanae* and *Teleonemia scrupulosa* in New Caledonia. They are two Coleoptera Chrysomelidae Hispinae : *Uroplata girardi* and *Octotoma scabripennis.*

Adults of these two chrysomelids are morphologically allied and have a very similar mode of life. Those of *U. girardi* (fig. 1) are from 4 to 5 mm long, of brown reddish colour and have a spotted thorax and elytra with longitudinal striae. Those of *O. scabripennis* (fig. 2) are from 5 to 7 mm long, brown and have elytra covered with irregular aristae.

Adults of the two species attack leaves, removing the upper side of the leaf, destroying the upper epidermis and the parenchyma, but leaving the lower epidermis intact. Damage is characteristic of Chrysomelidae, and produces a disjoined line of scars.

Adults of *U. girardi* also damage the margin of the leaf which curles and serves as a shelter for one or several individuals; this shelter can be also used by *O. scabripennis.*

Females insert their eggs through the upper sides of leaves and larvae miner the parenchyma. The simultaneous presence of adults and larvae can bring about the destruction of leaves and a reduction in plant vigor, but the infested leaves do not become detached before the withdrawal of adults.

Larvae of the two species are yellow with a brown head and spend all their life in the parenchyma of the same leaf. There are three larval stages. Pupae develop in a widening of the central part of a mine. Adults emerging from pupae wait one or two days in the gallery before leaving. The duration of the developmental stages from egg to adult in Hawaii is similar to that observed in Trinidad : from 34 to 45 days for *O. scabripennis* and from 37 to 40 days for *U. girardi*

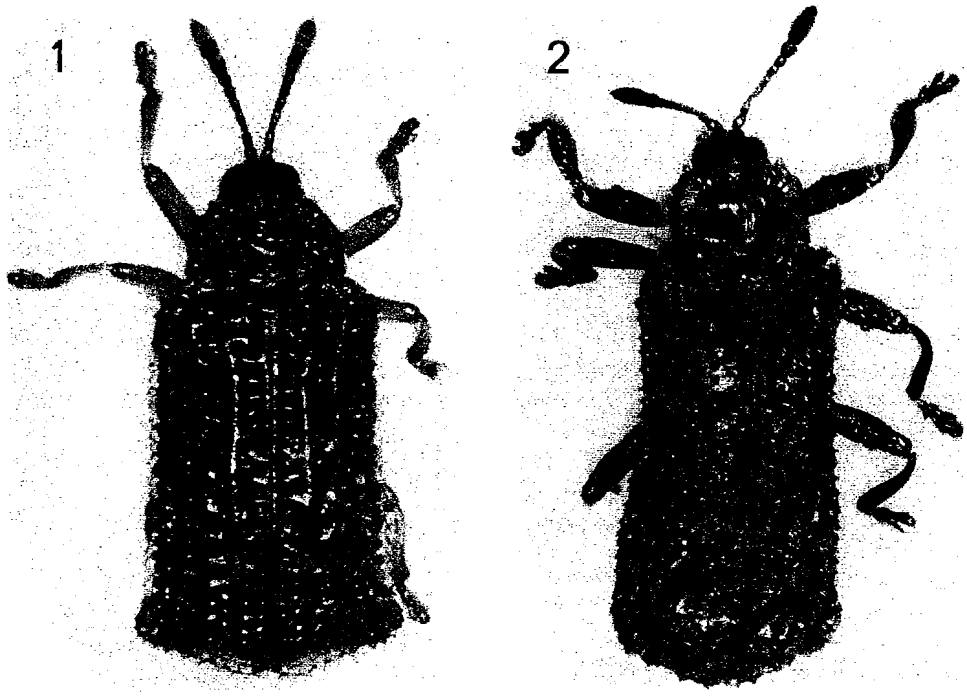

FIG. 1. — *Uroplata girardi* Pic (photographed by L. Skilling).
FIG. 2. — *Octotoma scabripennis* Guérin-Méneville (photographed by L. Skilling).

(HARLEY, 1969). The duration is from 30 to 40 days for the two species during the southern summer in South Africa when the mean maximum temperature is 30°C and the mean minimum temperature 18°C (CILLIERS, 1987).

After their emergence females of the two hispines feed actively for 3 or 4 weeks before they start to lay eggs (HARLEY, 1969).

O. scabripennis is active on plants in the full sunlight, whereas *U. girardi* prefers the cooler, half-shaded zones. These two phytophages of lantana enter a quiescent state in winter. In Hawaii almost the whole population of *O. scabripennis* is in diapause during the cool season, whereas the majority of the population of *U. girardi* remains active (HARLEY, 1969). In Natal the two species undergo diapause in the winter (CILLIERS, 1987).

The specifity of these two hispines for lantana was studied very thoroughly in both the laboratory and the field in Hawaii (BENNETT, 1967, *in* HARLEY, 1969) and in Australia (HARLEY, 1969 and 1971).

Host specificity tests carried out on tens of plants of economic or ornamental significance found that adult *O. scabripennis* could attack to a small extent beans, marjoram, mint and sesame without laying eggs, and could survive on teak, giving larvae that did not attain the adult stage. *U. girardi* can feed on sesame, *Lippia*

spp. and teak; the rare ovipositions observed on these two plants give larvae which do not live beyond the first instar.

4.2. Releases and their localisation

New Caledonia had to wait for about one year to be able to proceed with the releases of hispines. In addition to the administration formalities it was required that the selected species be abundant in Australia at a time when it would be most suitable for their multiplication in New Caledonia. The operation was organised by dispatching two lots of hispines to New Caledonia; insects were collected in the field in the Brisbane region on the day before the regular flight from Brisbane to Noumea.

The first consignment arrived on May 25th, 1977 at the onset of the cool season : it contained 550 *O. scabripennis* and 165 *U. girardi.* The second consignment arrived in the Territory on November 16, 1977, at the onset of the warm season; it contained 382 *O. scabripennis* and 604 *U. girardi.*

In agreement with the Management of the Rural Services of New Caledonia, the releases were made simultaneously on the western and the eastern coast (fig. 3).

Two localities were retained for the first releases :

• Koutio : in the immediate vicinity of Noumea with a large population of lantanas on the open terrain (mean annual amount of precipitation for the period 1956-1975 : 1,100 mm, Atlas of New Caledonia and Dependencies, ORSTOM, 1981).

• The forest station of Hienghene-Gaavatch : on the eastern coast where lantanas invade the undergrowth (mean annual amount of precipitation : 2,000-2,500 mm, the same reference).

— 400 *O. scabripennis* and 15 *U. girardi* were released at Koutio on May 25, 1977.

— 150 *O. scabripennis* and 150 *U. girardi* were released at Hienghene-Gaavatch on May 27, 1977.

On the arrival of the second consignment it was decided to increase the populations of the first two localities. A third site was also selected-the station Clavier at Gomen-located in the interior on the north-western coast where lantana plants were very hardy on grazing grounds (mean annual amount of precipitation : 1, 200 mm, the same reference) :

— 120 *O. scabripennis* and 100 *U. girardi* were liberated at Koutio on November 17, 1977.

— 120 *O. scabripennis* and 340 *U. girardi* were released at Hienghene-Gaavatch on November 18, 1977.

— 142 *O. scabripennis* and 164 *U. girardi* were released at Gomen on November 18, 1977.

4.3. Collection of the introduced species

— *Uroplata girardi* with its reddish-brown colouring is detected fairly easily on leaves of lantana. It seems that it has slowly established itself in the Territory, and has extended its range of distribution. The first adults were again found at

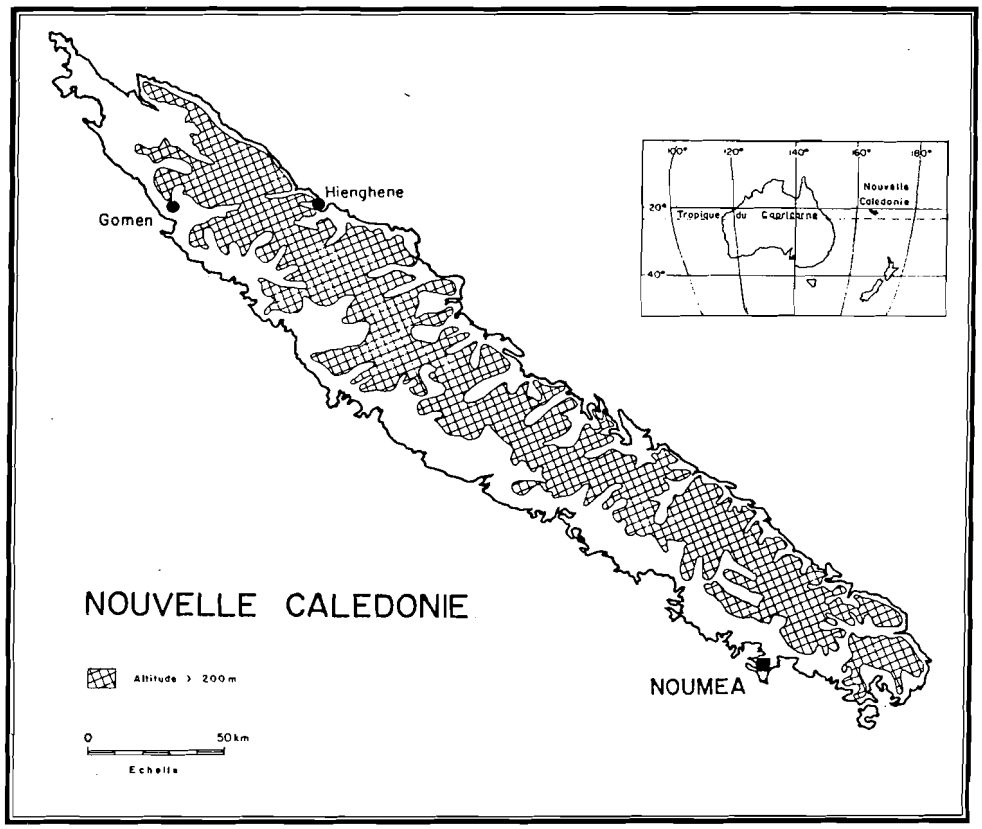

FIG. 3. — New Caledonia : location of the releases made.

Koutio at the end of May 1978, 1 year after the release of several adults and 6 months after the liberation of about another one hundred of these hispines. Subsequently an increasing number of individuals were collected on each visit to this site. At Hienghene-Gaavatch numerous specimens were captured in the underwood in May 1979, 2 years after the first release. At Gomen individuals were seen in May 1979, 18 months after a single release of 164 individuals.

This species spread from initial localities : it was found at Ouen-Toro, at the end of the Noumea peninsula, 10 km south of Koutio and at Mont Koghi, 6 km south-east of Koutio 500 m above sea-level ground.

Several specimens were also collected at Tao on the eastern coast north of Gaavatch. At these last stations *U. girardi* attacked lantanas very severely and almost destroyed them. Plants have become scarce in the isolated zone of Ouen-Toro where the hispines attack the few stems which still stand.

COLLECTIONS

• Western coast : at Koutio, 26/5/1978, then 19/12/1978 (J. GUTIERREZ, J. FAINICKA & C. IHILY); at Gomen, 11/5/1979 (J. G., J. F. & C. I.); at Noumea Ouen-Toro, 8/11/1982 (J. G.); Mont Koghi, 4/9/1983 (J. G.).

• Eastern coast : at Hienghene-Gaavatch, 10/5/1979 (J. G., J. F. & C. I.); at Tao, 15/12/1983 (J. CHAZEAU).

— *Octotoma scabripennis* has a more mimetic appearance on leaves of lantana than the preceding species, although more time is spent in looking for it. It was again seen 3 months after the first liberation of 400 individuals at Koutio at the height of the cool season and then again in an increasing number. Several specimens of it were again collected at Gaavatch 18 months after the initial release. Thereafter it was never caught again in the Gomen region. It thus seems that *O. scabripennis* has also established itself well in the Territory, but more discreetly than the first hispine. The 550 adults released at Koutio have prospered much less than the 165 adults of *U. girardi.*

COLLECTIONS

All the collections were made by the first author accompanied by J. FAINICKA and C. IHILY.

• Western coast : at Koutio, 19/7/1977, 26/5/1978 and 19/12/1978.

• Eastern coast : at Hienghene-Gaavatch, 10/5/1979.

5. CONCLUSION

The two Chrysomelidae specific to lantana, introduced in relatively modest numbers, thus established themselves well in the Territory. Their action complements that of the two phytophages (*Ophiomyia lantanae* and *Teleonemia scrupulosa*) imported 66 and 41 years ago, respectively. The mean temperature on the coast being of the order of 18°C at the height of the fresh season (July-August), their cycle is not interrupted by any diapause. One notices at most a slackening of their activity during the southern winter.

The studies made previously in other tropical countries suggested that *O. scabripennis* would develop well on the open stands of the western coast and *U. girardi* would prefer the half-shaded zones of the eastern coast. In reality, the second species seems to be more dynamic everywhere and *O. scabripennis* remains discreet even on the western coast in as much as it is less evident on the vegetation. It is possible that the multiplication of *U. girardi* is favoured by high relative humidity found everywhere on the mainland due to the influence of the ocean. Attacks by the latter hispine on lantanas in the environs of Noumea bring about, in any case, a clear regression of these plants, particularly those of the pink variety which has previously been little affected by the Tingid *Teleonemia scrupulosa.*

However, one must not imagine that an eradication of lantanas could be accomplished with these introductions only. It will no doubt be necessary to introduce other phytophages to reduce the lantana even further. Another species, a tingid *Leptobyrsa decora* Drake, was considered for importation and more

particularly one of its strains collected in Peru and reared by the CSIRO. *L. decora* is morphologically very different from *T. scrupulosa*, has a greater reproductive potential and effectively attacks numerous varieties of lantanas (HARLEY & KASSULKE, 1971; HARLEY, 1973). It is just as specific to lantanas as *T. scrupulosa*. It has been introduced into Hawaii and its extension in Australia seems to be limited by cold temperatures. One could reasonably think that it would have a good chance of success in New Caledonia.

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