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LES NOCTUELLES (LEPIDOPTERA NOCTUIDAE) NUISIBLES  
AUX CULTURES INDUSTRIELLES ET VIVRIERES EN GUYANE FRANCAISE  
THE NOCTUIDS (LEPIDOPTERA NOCTUIDAE) DANGEROUS TO FOOD AND  
INDUSTRIAL CROPS IN FRENCH GUIANA

J. F. Silvain <sup>1/</sup> and F. Thiberville <sup>2/</sup>

RESUME

Une revue des principales productions agricoles guyanaises est faite en signalant les problemes que posent les Lepidopteres noctuidae aux cultures dans cette region.

Une liste des noctuelles nuisibles aux cultures industrielles et vivrieres en Guyane francaise, ou susceptibles de la devenir, est presentee. Cette liste inclue des references provenant d'autres pays de la zone neotropicale.

Des donnees sont fournies sur la biologie des principales especes ainsi que sur les methodes de lutte employees en Guyane francaise contre ces insectes.

SUMMARY

Here is a review of the principal agricultural productions in French Guiana, pointing out the problems caused on the crops in this region by noctuid moths.

We present a list of noctuids harmful, or capable of becoming harmful, to industrial and food crops in French Guiana. This list includes references arising from other countries in the neotropical zone.

<sup>1/</sup> Chargé de Recherches, Laboratoire d'Entomologie, Office de la Recherche Scientifique et Technique Outre-Mer, Cayenne - Guyane Francaise

<sup>2/</sup> Service Départemental d'Agronomie de la Guyane

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The data is furnished upon the biology of the main species, as well as on the methods employed to control these pests in French Guiana.

INTRODUCTION: GENERAL REMARKS ON AGRICULTURE IN FRENCH GUIANA

Agriculture in French Guiana has been profoundly changing of late years. The traditional forest clearing methods are rapidly being replaced by modern farming, which in certain fields, may well lead to auto-sufficiency and, in due course, export.

This development concerns only the costal strip. The interior which is dense, primitive forest, is practically uninhabited.

Deforestation, the relinquishment of traditional methods, the increase in the cultivated surface-area, the spread of single-crop and perennial cultivations (pastures, sweet lime, passion-fruit), the use of insecticides, all these techniques have induced sudden upheavals that have disturbed the balance between host-plants, helpful insects, crop pests. The problems caused by the latter have lately assumed considerable proportions.

Simultaneously as farming techniques improve, the farmers are increasingly concerned by the damage caused by these pests.

As a result, they are beginning to ask for information and the means to combat crop damage. In general, a perusal of the check-list of the principal types of crop devastating insects, along with a deeper knowledge of their ecology, should allow us to assist the farmers in quite a considerable way.

It is with this very purpose in mind that we have carried out the present study of noctuid-moths which are harmful to crops produced in French Guiana.

THE MAIN AGRICULTURAL PRODUCTIONS - A BRIEF ACCOUNT OF THE CROP DEVASTATOR NOCTUIDS CONNECTED WITH THESE

Since 1976, cattle-rearing has been rapidly developing (+ 15 to 20% per year, as per number of heads and fodder producing surfaces). In 1982, 12,000 cattle-heads and 4,650 hectares of prairie-land were registered. French Guiana will be in a position to export beef in the very near future. The main problem encountered by the farmers in the maintenance

of their pastures, apart from weeds, is the Spodoptera frugiperda (J. E. SMITH) noctuid which can cause alarming damage during certain periods of the year.

Sugar cane (grown with a view to producing rum) is a traditional cultivation occupying large surfaces in the Cayenne and Saint Laurent of Maroni belts. Several Leucania are present in these fields. It is, nevertheless, difficult to evaluate the extent of damage caused by these insects due to a lack of extensive study and precise data.

Rice-cultivation, be it pluvial (as in the Cacao, Iracoubo and Saint Laurent belts) or irrigational (as in the Mana polder) is being greatly expanded. The presence of Spodoptera frugiperda and Mocis latipes has forced farmers to call upon aerial-sprayers which are extremely costly. It has become necessary to work out a warning system.

Cassava, cultivated traditionally in forest clearings, today forms a part of the human diet. It were planned that it should serve as fodder for cattle, then this would induce a multiplication of surfaces where this tuber is grown, as well as a mechanization of its cultivation and harvest.

There are some years when two types of noctuids-moths, Spodoptera frugiperda and Mocis latipes can make havoc of the maize plantations where it is grown on a big scale. However, it is worth remembering that in French Guiana maize is cultivated mainly in forest clearings.

Every year larger and larger surfaces are consecrated to citrus fruits (oranges, grapefruit and especially sweet lime). It is important to keep a constant watch on the orchards.

Passion fruit (passiflores) is grown on a large scale by refugees from South East Asia, and is produced extensively in the Javouhay and Cacao regions. Experiments are being carried out by the IRFA (Research Institute for Fruits and Agrumes) in Montsinery.

Truck-crops, cultivated traditionally on soil or under hydroponic conditions (tomatoes, cabbages, beans, salads, cucumbers) often permit two to four harvests per year per plot. This encourages the rapid multiplication of noctuids of Spodoptera genus and of Plusiinae. As for vegetables or local fruits grown on a small scale in forest clearings all along the costal strip, little is known about the harmful effects of these noctuids for want of field-study and interest on the part of the farmers.

One must also mention that the natural milieu (forest or savannah) acts as a supplier of fauna both harmful and helpful to crops, and this milieu is located, in all cases, within immediate proximity (from a few meters to a few kilometers) of the fields.

3) LISTE DES NOCTUELLES NUISIBLES AUX CULTURES EN GUYANE FRANÇAISE OU SUSCEPTIBLES DE PRESENTER UNE IMPORTANCE ECONOMIQUE  
LIST OF NOCTUIDS HARMFUL TO CROPS IN FRENCH GUIANA OR CAPABLE OF BECOMING HARMFUL

Cultures --- Crops	Noctuelles nuisibles à cette culture en Guyane Française ----- Noctuids harmful to that crop in French Guyana	Autres pays où l'espèce est signalée sur cette culture ----- Other countries where the species has been found on that crop	Noctuelles signalées en Guyane et trou- vées sur cette culture dans d'autres pays ----- Noctuids present in French Guiana and found on that crop in Other countries
1- CULTURES PRINCIPALES ou dont les superficies sont en augmentation --- Main crops 1) Cultures fourragères ----- Fodder crops			
Graminées fourragères --- Pasture Grasses  (Digitaria sp.) (Brachiaria sp.)	- <u>Spodoptera fugiperda</u> - <u>Mocis latipes</u> - Mocis disseverans - Leucania senescens - Leucania jalsicana - Thloptera aurifera	FL(16), GdA(28), PA(12), VEN(19), BRE(4), EQ(22) FL(16), GdA(28), 27), PA(12, 13) VEN(1, 18), SUR(10), BRE(4), COL(7), EQ(22) GdA(27) GdA(28)	- <u>Spodoptera eridania</u> FL(15)
2) Cultures industrielles ou d'exportation --- Industrial or export crops			

Canne à sucre --- Sugar cane (Saccharum officinarum L.)	- <u>Leucania microsticha</u>	BRE (4)	- <u>Agrotis repleta</u> GdA(28) - <u>Leucania senescens</u> GdA(28) (L. latiuscula) - <u>Spodoptera frugiperda</u> FL(15), GdA(28), PA(2, 12, 20) EQ(22), VEN(19), SUR(10), CH(3) - <u>Mocis latipes</u> GdA(27, 28), PA(12, 20), VEN(18), SUR(10), BRE(4)
Riz / Rice (Oryza sativa L.)	- <u>Spodoptera frugiperda</u> - <u>Mocis latipes</u>	VEN(19), SUR(10), BRE(4), CH(3), EQ(22) GdA(27), VEN(18), SUR(10) BRE(4), CH(3)	- <u>Leucania humidicola</u> BRE(4) - <u>Leucania juliscana</u> BRE(4) - <u>Leucania microsticha</u> BRE(4) - <u>Heliothis zea</u> CH(3)
Sorgho / Sorghum (Sorghum vulgare Pers)	- <u>Spodoptera frugiperda</u> - <u>Mocis latipes</u>	PA(9), SUR(10), BRE(4) BRE(4)	- <u>Anticarsia gemmatalis</u> PA(9)
Soja / Soybean (Glycine max (L) Men)	- <u>Anticarsia gemmatalis</u> - <u>Spodoptera frugiperda</u> - <u>Mocis latipes</u>	FL(15), GdA(28), SUR(10), BRE(4), EQ(22) VEN(19), SUR(10), BRE(4), EQ(22) BRE(4)	- <u>Agrotis repleta</u> SUR(10) - <u>Pseudoplusia includens</u> USA(11) - <u>Heliothis zea</u> EQ(22)
Agrumes / Citrus fruits (Citrus Sp.)	- <u>Spodoptera frugiperda</u>	VEN(19), BRE(4), CH(3)	- <u>Spodoptera latifascia</u> FL(15) - <u>Heliothis zea</u> FL(15) - <u>Ophisma tropicalis</u> BR(4) - <u>Gonodonta clotilda</u> VEN(1) - <u>Gonodonta incurva</u> FL, GdA, PA, AmSud(25) - <u>Gonodonta pyrgo</u> VEN(1)
Fruits de la passion (Passiflora edulis Sirm.) --- Passion fruits			- <u>Spodoptera frugiperda</u> BRE(4)

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3) Cultures Maraichères --- Food crops			
Haricots / Beans (Phaseolus sp. Vigna sp.)			- <u>Agrotis repleta</u> BR(4) - <u>Spodoptera eridania</u> BR(4, 23), CH(3) - <u>Spodoptera frugiperda</u> FL(15), PA(2,13), SUR(10), BR(4, 23), CH(3) - <u>Spodoptera latifascia</u> BR(23) - <u>Heliothis zea</u> FL(15), GdA(28), PA(12), BR(4) - <u>Anticarsia gemmatalis</u> PA(12, 13), VEN(1), SUR(10), BR(4, 23) - <u>Pseudoplusia includens</u> PA(13), BR(4) (oo Cramer)
Tomate / Tomato (Lycopersicon esculentum HILL)	- <u>Spodoptera eridania</u> - <u>Pseudoplusia includens</u> - <u>Spodoptera dolichos</u> - <u>Spodoptera latifascia</u> - <u>Spodoptera androgea</u>	FL(15), GdA(28), PA(12), BR(4), CH(3) USA(11), GdA(28), PA(13) BR(4) GdA(12), PA(12), BR(4) GdA(28), PA(12), BR(4) GdA, PA(12)	- <u>Agrotis repleta</u> SUR(10), BR(4) - <u>Anicla infecta</u> PA(15) - <u>Spodoptera frugiperda</u> GdA(28), PA(13), VEN(19), SUR(10), CH(3), EQ(22) - <u>Spodoptera marina</u> BRE(4) (Sp. ornithogalli) - <u>Heliothis zea</u> FL(15), GdA(28), PA(2), BRE(4), CH(3) - <u>Spodoptera sunia</u> EQ(22) - <u>Gonodonta rutrix</u> GdA, PA, AmSud(25)
Aubergine / Egg-plant (Solanum melongena L.)			- <u>Anicla infecta</u> GdA(13) - <u>Spodoptera eridania</u> PA(13) - <u>Spodoptera frugiperda</u> GdA(28), PA(13), VEN(19), SUR(10), BRE(4), CH(3) - <u>Spodoptera marina</u> BRE(4) (Sp. ornithogalli) - <u>Spodoptera sunia</u> GdA(13) - <u>Heliothis zea</u> GdA(28), BRE(4), CH(3)

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Piment / Red pepper (Capsicum frutescens WLD.)			- <u>Anicla infecta</u> PA (13) - <u>Spodoptera frugiperda</u> GdA (28), PA (13), VEN (19), BRE (4) - <u>Spodoptera eridania</u> GdA (28) - <u>Spodoptera latifascia</u> BRE (4) - <u>Spodoptera macima</u> BRE (4) - <u>Heliothis zea</u> BRE (4), CH (3)
Poivron / Pepper (Capsicum annuum L.)			
Concombre / Cucumber (Cucumis sativus L.)			- <u>Spodoptera eridania</u> BR (4) - <u>Spodoptera frugiperda</u> PA (2), VEN (19) - <u>Heliothis zea</u> BRE (4), CH (3)
Melon / Melon (Cucumis melo)			- <u>Agrotis repleta</u> BRE (4) - <u>Spodoptera frugiperda</u> BRE (4), CH (3) - <u>Heliothis zea</u> BRE (4)
Pastèque / Watermelon (Citrullus vulgaris Schrad)			- <u>Agrotis repleta</u> BR (4) - <u>Spodoptera frugiperda</u> VEN (19) - <u>Heliothis zea</u> BRE (4), CH (3)
Salade / Lettuce (Lactuca sp.)	- <u>Argyrogramma verruca</u> - <u>Spodoptera marina</u> - <u>Platysenta sutor</u> - <u>Pseudoplusia includens</u>	BRE (4)	- <u>Agrotis repleta</u> BRE (4) - <u>Spodoptera frugiperda</u> BRE (4) - <u>Heliothis zea</u> BRE (4), CH (3)
Choux / Cabbage (brassica sp.)	- <u>Spodoptera eridania</u> - <u>Agrotis repleta</u> - <u>Spodoptera dolichos</u> - <u>Spodoptera frugiperda</u>	PA (12) SUR (10), BRE (4), GdA (5), PA (1), VEN (19) SUR (10), BRE (4), CH (3)	- <u>Heliothis zea</u> CH (3), EQ (22) - <u>Argyrogramma verruca</u> SUR (10) - <u>Pseudoplusia includens</u> GdA (28), PA (12), BR (4) (oo. Cramer)

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II- CULTURES SECONDAIRES			
Secondary crops			
1) Cultures Vivrières (Abattis)			
Food crops			
Maïs / Maize (Zea mays L.)	- <u>Spodoptera frugiperda</u> - <u>Mocis latipes</u> - <u>Heliothis zea</u>	FL(15), GdA, PA(12, 13, 28) Am.Sud(3, 4, 10, 19,22) GdA(27), PA(8), VEN(1, 19) BRE(4), COL(7), CH(3) GdA, PA(8, 13,28), BRE(4) EQ(22), CH(3)	- <u>Agrotis repleta</u> BRE(4) - <u>Anicla infecta</u> BRE(4) - <u>Spodoptera androgea</u> PA(12), SUP(16) - <u>Spodoptera latifascia</u> PA(2) - <u>Cydosia nobilitella</u> PA(13)
Manioc / Cassava (Manihot utilissima Pohl.)	- <u>Spodoptera eridania</u>	BRE(4)	
Patate douce/Sweet potato (Ipomoea batatas Polr.)			- <u>Spodoptera eridania</u> PA(8), BRE(4) - <u>Spodoptera frugiperda</u> PA(2), BRE(4) - <u>Spodoptera sunia</u> PA(12)
Pois d'Angole/Pigeon pea (Cajanus sp.)			- <u>Heliothis zea</u> PA(8) - <u>Anticarsia gemmatilis</u> PA(8, 12)
Gombo / Okra (Hibiscus esculentus Medik)			- <u>Spodoptera frugiperda</u> BRE(4) - <u>Heliothis zea</u> FL(15), BRE(4) CH(3)

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2) Coton (Abattis) / Cotton (Gossypium sp.)			<ul style="list-style-type: none"> <li>- <u>Agrotis repleta</u> BRE(4)</li> <li>- <u>Callopietria floridensis</u> BRE(4)</li> <li>- <u>Elaphria agrotina</u> BRE(4)</li> <li>- <u>Platygenta concisa</u> GdA(28)</li> <li>- <u>Spodoptera eridania</u> BRE(4)</li> <li>- <u>Spodoptera dolichos</u> BRE(4)</li> <li>- <u>Spodoptera frugiperda</u> FL(15), VEN(19), SUR(10) BRE(4), CH(3)</li> <li>- <u>Spodoptera latifascia</u> BRE(4)</li> <li>- <u>Spodoptera marina</u> BRE(4)</li> <li>- <u>Heliothis zea</u> FL(15), GdA(28), PA(2, 12), BRE(4), CH(3)</li> </ul> <p>(* Nous n'avons pas récolté en Guyane l'espèce <u>Platygenta argillacea</u> (Hübner) espèce signalée au Surinam (10) et au Brésil (4)</p>
3) Cultures expérimentales Experimental crops			
Café / Coffee (Coffea sp.)			<ul style="list-style-type: none"> <li>- <u>Spodoptera dolichos</u> BRE(4)</li> <li>- <u>Spodoptera frugiperda</u> BRE(4)</li> <li>- <u>Mocis latipes</u> BRE(4)</li> <li>- <u>Letis mycerina</u> GdA(28)</li> </ul>
Arachide / Peanut (Arachis hypogaea L.)			<ul style="list-style-type: none"> <li>- <u>Agrotis repleta</u> SUR(10)</li> <li>- <u>Spodoptera frugiperda</u> PA(6), VEN(19), SUR(10), BRE(4), EQ(22)</li> <li>- <u>Spodoptera sunia</u> PA(6)</li> <li>- <u>Heliothis zea</u> PA(6), CH(3)</li> <li>- <u>Mocis latipes</u> BRE(4)</li> <li>- <u>Anticarsia gemmatalis</u> BRE(4), GdA(28), PA(8), EQ(22)</li> </ul>

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Eucalyptus (Eucalyptus sp.)			- <u>Spodoptera eridania</u> BRE(4)
Ricin / Castor bean (Ricinus communis)			<ul style="list-style-type: none"> <li>- <u>Agrotis repleta</u> BRE(4)</li> <li>- <u>Spodoptera eridania</u> BRE(4)</li> <li>- <u>Spodoptera frugiperda</u> VEN(19)</li> <li>- <u>Spodoptera marina</u> BRE(4)</li> </ul>
Tabac / Tobacco (Nicotiana tabacum L.)			<ul style="list-style-type: none"> <li>- <u>Agrotis repleta</u> BRE(4)</li> <li>- <u>Spodoptera eridania</u> GdA(28), BRE(4)</li> <li>- <u>Spodoptera frugiperda</u> VEN(19), SUR(10)</li> <li>- <u>Spodoptera latifascia</u> GdA(28)</li> <li>- <u>Spodoptera sunia</u> GdA(28)</li> <li>- <u>Heliothis zea</u> GdA(28), BRE(4), CH(3)</li> </ul>
4) Arbres fruitiers Fruit trees			
Goyavier / Guava (Psidium guajava L.)			- <u>Spodoptera frugiperda</u> VEN(19)
Manguier / Mango (Mangifera indica L.)			<ul style="list-style-type: none"> <li>- <u>Spodoptera frugiperda</u> VEN(19)</li> <li>- <u>Spodoptera marina</u> BRE(4)</li> </ul>
Pommes cannelles Sugar apple (Anona sp.)			- <u>Gonodonta clotilda</u> Antilles Am.Sud(25)

Abbreviations : FL = Floride, GdA = Grandes Antilles, PA = Petites Antilles, VEN = Vénézuéla, SUR = Surinam, BRE = Brésil, COL = Colombie, EQ = Equateur, CH = Chili, Am.Sud = Amérique du Sud.

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DATA CONCERNING THE PRINCIPAL SPECIES HARMFUL TO CROPS

Spodoptera frugiperda (J.E. SMITH)

This extremely polyphagous noctuid-moth is the most important species in French Guiana from economic point of view. It is seen mainly on graminaceous fodder (24), rice and soyabean. As the dry season approaches, fodder, and in particular Digitaria swazilandensis, the one most extensively used in French Guiana, suffers great devastation owing to this noctuid-moth in regions where this season often causes grass-deficits.

During tillering, or between the stages of tillering and shooting, the repeated attacks of Spodoptera frugiperda on pluvial and irrigated rice oblige the cultivators to constantly carry out expensive insecticide treatments.

Pullulations of the Spodoptera frugiperda caterpillars on soyabean (when experimented or cultivated) have been repeatedly observed; the caterpillars feeding first on adventitious grasses before attacking the soyabean plants.

Spodoptera frugiperda also destroys maize and sorghum crops in French Guiana. The former, grown mostly in traditional forest clearings, has rarely been cultivated for industrial purposes; and when such was the case, the havoc worked by the caterpillars entailed frequent pesticide treatments.

Lastly, it has come to our notice quite by accident that the Spodoptera frugiperda caterpillars are found on tomatoes and cabbages, whereas eggs and larva in the first stages have been discovered on citrus leaves (21).

The species is present all the year round in French Guiana. It can produce up to 12 successive generations. The female can lay as many as 1,700 eggs in seven consecutive nights; the rate of hatching ranging between 65 and 93%. The development from egg to adult is normally completed in 23 to 26 days under the climatic conditions prevalent in French Guiana. It is noteworthy that, on an average, the female develops two days sooner than the male. The caterpillar undergoes six to seven larval stages (Data obtained on Digitaria swazilandensis).

In the pastures, where we studied this species in far greater detail, the Spodoptera frugiperda populations appears to fluctuate during the year, reaching their lowest level during or at the end of the main dry season (October-November) and then rising again during the rainy season (mid-November to the beginning of August) when we generally witness two or three abundant periods stretching over two to four months. These abundant periods are followed by periods when the populations drop back to a sparse level. In the pastures, pluviometry seems to play a very important part in this sequence of abundant and sparse population periods, as do the working of a great parasitic complex and the various pathogenic agents.

In the case of graminaceous fodder, as in that of rice or soyabean, the economic importance of Spodoptera frugiperda drastically varies from one year to another (personal observation and 14) depending upon whether or not there have been population explosions. We also discovered that so far as graminaceous fodder and rice were concerned, they were seemingly attacked more frequently during the first few years after the land had been cleared and cultivation started, and these attacks would consequently diminish gradually as a new ecological order established itself.

The most commonly used pesticides to fight against this noctuid-moth are deltamethrine and methidathion with a moistening agent added on. Treatments are applied from the ground or by air. Other pesticides not that frequently used, are a monocrotophos-parathion methyl mixture (Azobane R.) in particular, and when it comes to maize, diazinon or fonofos applied to the cornet of the plant (14).

In the case of graminaceous fodder, the absence of a regular supervision of the grasses reduces the efficiency of pesticide treatments. In general, they are carried out much too late when the caterpillar populations are already either in the last stages of their development or in the pupal one. To correct this situation, entomologists from the O.R.S.T.O.M. Centre in Cayenne are currently engaged in working out a warning system based on the use of pheromone traps. A study of the possibilities of using methods of biological counter-action is also under way (pathogenic and parasitic agents).

Other noctuid-moths of the Spodoptera genus

In French Guiana, one meets with eight other noctuids belonging to the Spodoptera genus:

- Spodoptera androgea (CRAMER),
- Spodoptera dolichos (FABRICIUS),
- Spodoptera evanida (Schaus),
- Spodoptera eridania (CRAMER),
- Spodoptera latifascia (WALKER),
- Spodoptera marima (SCHAUS),
- Spodoptera sunia (GUENEE),
- Spodoptera sp., in the course of being defined.

Economically speaking, Spodoptera eridania is proving to be the most important species among those mentioned above, being very harmful to truck crops, and especially to tomatoes, on which it is often seen. It has also been found on cabbages. The young larvae are gregarious. Pupation occurs in the soil.

Spodoptera dolichos, another pest of truck crops, has been found on tomatoes and, on rare occasions on cabbages.

Spodoptera latifascia and Spodoptera androgea have been gathered from tomato-plants.

Spodoptera marima is a species closely resembling Spodoptera ornithogalli (GUENEE) particularly when it comes to the genitalia. Nevertheless, it is smaller in size and does not possess, in the adult stage, the sexual dimorphism of the Spodoptera ornithogalli, and replaces this species in French Guiana and Brasil (26). It has been found on tomatoes.

The truck-crop farmers generally carry out preventive pesticides treatments regularly with the help of diazinon, methidathion or deltamethrine. Since truck-crops, especially tomatoes, yield a high profit in French Guiana, the farmers these days seem quite willing to accept the cost incurred by these treatments.

Mocis latipes and Mocis disseverans

Two species of the Mocis genus have been noticed in French Guiana: Mocis latipes (GUENEE) and Mocis disseverans (WALKER).

The former of the two is principally met with on graminaceous fodder (24) and rice, but our attention has also been drawn to its presence on maize and soyabean. As regards soyabean, the Mocis latipes caterpillars, like the Spodoptera frugiperda ones, seem to feed on the leaves only after having consumed the adventitious grasses present inside the field.

In the pastures, Mocis latipes make their appearance in periods usually corresponding to those of the Spodoptera frugiperda, and it is not rare to find caterpillars of the two species pullulating at the same time. This species may cause considerable devastation, although varying a great deal from year to year. It is distinguished, ever more than Spodoptera frugiperda, by its population explosions which are difficult to explain. The Mocis latipes caterpillars and larvae, although spared by most parasites, undergo heavy predation pressure by hymenoptera Vespidae. Between two abundant periods, this species can barely hold its own, the lowest populations being recorded in the dry season. The female Mocis latipes has a far lower fecundity than that of the Spodoptera frugiperda (a maximum of 350 eggs per female). In the pastures, light trapping of adult (Mocis latipes) gives us a good estimate of the abundant periods of caterpillars of this species.

The second species of the Mocis genus, Mocis disseverans occurs in small numbers in the pastures during the rainy season.

Contrary to Mocis latipes, Mocis disseverans does not appear to produce population explosions; it is, therefore, of far less economic importance than the former. In the absence of morphological criteria, Mocis disseverans caterpillars may be distinguished from the others by their lighter colour.

The pesticide treatments applied against caterpillars of the Mocis genus of noctuids are the same as those used for Spodoptera frugiperda caterpillars.

Plusiinae

Two noctuid-moths from the Plusiinae sub-family, economically important in French Guiana, are Argyrogramma verruca (FABRICIUS) and Pseudoplusia includens (WALKER). Both are pests of truck-crops in this country.



Argyrogramma verruca has frequently been found on lettuce and, on rare occasions, on cabbages. When using light trapping, the abundant periods of this species occur during the rainy season from December to August.

Pseudoplusia includens, better known as oo Cramer, has been found on tomatoes and exceptionally, on lettuce.

The pesticide treatments used against these two noctuids are identical to those mentioned in connection with the Spodoptera family, and our remarks about those treatments hold equally good for the Plusiinae noctuids.

#### Leucania

Several species of Leucania have been caught by light traps in French Guiana. It is extremely difficult to distinguish between these species in their adult stage, the genitalia providing the only clue permitting such a differentiation. Several species have been included in our list of noctuids harmful to crops in French Guiana, which has only indicative value, since there are far too many synonymities and confusions within this genus. For this reason, it ought perhaps to be put to a thorough examination based on a study of the genitalia.<sup>+</sup>

Two species of the Leucania family are secondary pests of graminaceous fodder in French Guiana: Leucania senescens MOSCHLER and Leucania jaliscana SCHAUS. The former, the commoner of the two, is more or less abundant, depending on the years. It is a familiar sight in the rainy season. The second one is rare, particularly abounding from January to March.

Another Leucania, the Leucania microsticha HAMPSON has been discovered on sugar-cane, but its economic influence is not yet known.

No special pesticide treatments are used for Leucania. In the pastures, the treatments applied for

<sup>+</sup> Some preliminary work, in collaboration with an American research Scientist, Dr. ADAMS, is under way in French Guiana and in the French West Indies.

Spodoptera frugiperda and Mocis latipes are effective in destroying Leucania as well.

#### Anticarsia gemmatalis

Very little data concerning the biology and the ecology of the Anticarsia gemmatalis HUBNER in French Guiana is available, since the cultivation of soyabean on an industrial scale has made its appearance only in very recent years.

#### REMARKS RELATIVE TO THE USE OF PESTICIDES IN FRENCH GUIANA

Two general observations may be made concerning the use of pesticides to fight against noctuid-moths in French Guiana:

- The main problem that arises when pesticides are applied to destroy defoliator noctuids is the real remanence that remains when we use these products in the extreme pluviometric conditions prevailing in the rainy season in French Guiana (Depending on the regions, the annual rainfall ranges between 2.5 and 4 meters). Often the pesticides treatments are rendered ineffective by the rain as it washes the leaves, particularly in the case of contact pesticide of the pyrethroid type.

It would hence, be necessary to proceed with experiments designed to adapt spraying techniques to the climatic conditions prevailing in this region.

- Taking into account the limited scope of the Guianese market, very few products are locally available. Efficiency, therefore, is not the only criterion and the choice is mostly made according to the availability of a product. In such a situation, several farmers buy their supplies from Surinam, where the range of available phytosanitary products is far wider. This in turn, presents problems of compliance with the French laws in force in French Guiana.

#### CONCLUSION

One may witness a multiplication of the problems dealing with crop pests running parallel to the development of agriculture in French Guiana. As far as Lepidoptera noctuids are concerned, we find that most of the species of an

economic importance that have been check-off in the neighboring countries and generally in all the neotropical zone exist in French Guiana.

The economic importance of each of these potential ravagers will, therefore, depend upon the surface area covered by that or those crops favourable to their multiplication; and one may easily expect that the introduction or expansion of a certain type of crop is bound to be accompanied with the emergence of a new problem of noctuid pests. Climatic conditions in French Guiana, and especially the long duration of the rainy season, are propitious to the sustenance of large noctuid populations during most of the year.

Spodoptera frugiperda is, at the moment, the most important noctuid from the economic view point, most of the efforts in the theoretical and applied research in French Guiana being directed towards it. It would be desirable that scientists working on this species in different Caribbean countries, as well as, in the entire neo-tropical zone cooperate more closely and increase the exchange of data.

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