Apidologie, 1980, 11 (4), 341-350.

NECTAR AND POLLEN RESOURCES FOR STINGLESS BEES (MELIPONINAE, HYMENOPTERA) IN SURINAM (SOUTH AMERICA)

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SUMMARY

By means of several methods information on the floral resources of the stingless bees of Surinam has been obtained. This study reports on about 100 plant species visited by 37 species of stingless bees. It appears that there is a considerable overlap in the food plants of the different bee species. Some small flowers or flowers with a long and narrow corolla seem to be visited exclusively by small bees : *Asystasia* species by *Trigona pallens* and *Orthosiphon grandiflorus* by *Plebeia minima*. *Solanum* species are visited exclusively by the bees (*Melipona* spec., *T. fulviventris guianae*) that are able to loosen the pollen by vibrating.

For the first time it is reported that stingless bees (*M. favosa, M. compressipes, T. hyalinata branneri)* collect pollen from Polygonacaea (*P. acuminatum, Triplaris surinamensis, Cocoloba lucidula*).

Most important food plants for *M. favosa* are : *Avicennia germinans, Aciotes dichotoma, Syzygium cumini, Polyganum acuminatum* and *Solanum* species.

INTRODUCTION

Stingless bees form a group of pantropical social bees. Not much has been published about their occurrence in Surinam. SCHWARZ (1948) mentions a number of species collected by the Cornell University Expedition there. A more recent publication on Meliponinae in Surinam is by REYNE in 1962. His paper is a mere summation of all stingless bees occurring in Surinam, with notes on the specimens (collector, location of sampling, and other observations). In most cases REYNE (1962)

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observed bees chewing* on leaves or fruits. *Trigona fulviventris guianae* was seen on bananaflowers (Musa), but no further reference to either chewing or foraging was given. His list gives a total of 28 Meliponin bees. Since then new material has been added, now mainly in the collection of the Rijksmuseum voor Natuurlijke Historie at Leiden. This material is being studied and results will be published in due time (DINGEMANS-BAKELS, in prep.). About twice as many species are known now. The observations of REYNE (1962) are to our knowledge the only data on food sources for stingless bees in Surinam.

The first to gain knowledge on floral resources for stingless bees in tropical America was DUCKE (1901, 1902). He observed flower visits in Parā (North-east Brasil). After these publications very little appeared to enhance our knowledge in this field except for incidental information in taxonomic studies and in studies on pollination biology. However the interest in food sources and related problems (e.g. foraging behaviour, recruitment) has been growing recently (LINDAUER and KERR, 1958; JOHNSON and HUBBELL, 1974; ABSY and KERR, 1977; HUBBELL and JOHNSON, 1978; ROUBIK, 1979 and IWAMA and MELHEM, 1979).

Object of this study is to procure data on floral resources for stingless bees in Surinam. The knowledge on floral ecology may also benefit from this study by giving information on potential native pollinators.

It is fortunate that the flora of Surinam has been studied in great detail. PULLE started a comprehensive study on it which has been continued by many other botanists mainly from the Botanical Department of Utrecht University. Apart from native plants, the flora of Surinam consists of a large number of introduced plants. Immigrants from India and Java (Indonesia) had brought with them large numbers of garden and edible plants. (All plants mentioned by REYNE (1962), apart from bananas, are introduced plants.)

Data were obtained in different ways. Accompanying notes of a museum collection of Meliponin bees provided information on which plants the bees had been caught. Pollen and honey samples collected by ENGEL during a stay of two months (August-September, 1978) in Surinam were microscopically analyzed. So were the samples that were taken from the stingless bee colonies originating from Surinam and kept at the Laboratory of Comparative Physiology in Utrecht. During this stay field observations were also made.

MATERIALS AND METHODS

Most bees of the museum collection were caught in the savannah area of Surinam. These bees and those caught during field work were all identified by DINGEMANS-BAKELS. Field work was done mainly in

* Meliponins chewing on plants : *Trigona amalthea, T. dallatorreana, T. kaieteurensis* and Trigona spec. on Citrus leaves; *T. amalthea* on *Vigna sinensis* (= *V. unguiculata* (L.) Walp., Papillionaceae), *Colocasia antiquorum* (= *C. esculenta* (L.) Schott., Araceae), *Artocarpus incissus* (= *A. communis* J. R. and G. FORTSTER, Moraceae) and young bananas (Musa spec., Musaceae).

the coastal area, the immediate surroundings of the capital Paramaribo, and south of Paramaribo in the polders. The plants on which bees were found were dried and afterwards identified. These identifications were later verified at the Land's Herbarium in Paramaribo.

Getting samples of honey and pollen from tended colonies of Meliponins proved to be difficult. Only two beekeepers who kept stingless bees were known, both were living in the coastal area. Species kept were *Melipona favosa* and *M. compressipes*. At the Laboratory of Comparative Physiology at Utrecht, some *M. favosa* colonies originating from Surinam were kept for behavioural studies. Directly upon arrival in the Netherlands samples were taken from these too.

The total number of samples thus obtained is 27. Of these 23 samples have been taken from pollen storage pots (21 from *M. favosa* and 2 from *M. compressipes*), 3 pollen baskets (1 *M. favosa* and 2 *M. compressipes*) and unfortunately only one honey sample *(M. favosa)*.

The material was prepared by the standard acetolysis method as given by REITSMA (1969). Besides evident advantages (material being clean and clear, durability of the slides) this method has the disadvantage in that pollen of several families like the Musaceae and Lauraceae is destroyed during this process.

As no palynological literature dealing with plant taxa from Surinam exists a reference slide collection had to be made. The initial choice of plants for this collection was based on data given by DUCKE (1901, 1902), ASBY and KERR (1977) and our own information. Plants chosen for the reference slide collection came from the Utrecht Herbarium, and when available plants originating from Surinam were used. Afterwards the pollen found in the samples was compared with that of the reference slide collection.

Both ways of obtaining data have their restrictions. First, bees may be caught on plants which do not contribute to their diet (vide REYNE, 1962). As collecting bees in trees is rather difficult trees and epiphytes will be underrepresented. Secondly, no traces of flower visits will be found if pollen is detroyed during acetolysis. The same applies in the case of nectar robbing, a trait not rare for Trigona (BARROWS, 1976). And thirdly, the number of pollen types that can be identified depends on the reference slide collection being complete.

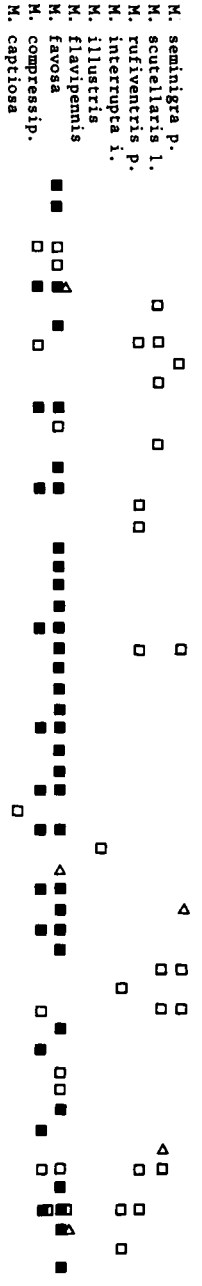
RESULTS

All data, comprising those from the museum collection, microscopical analysis and field observations, are shown in Table I*a*, I*b* and I*c*. Table I*a* contains the data for the genus Melipona, I*b* for true Trigona, and I*c* for the other genera.

In some cases the vernacular names of plants on which the bees were caught have been given. These names often indicate a whole genus or even a whole family. This is the case with « tingimoni » : Burseraceae and « purslane » : Portulacaceae. « Koenami, another vernacular name given, is a fish poison and may be derived from very different plants. The following plants are used in Surinam as « koenami » : Clibadium spec. (Compositae) and *Tephrosia toxicara* (Papillionaceae). Meliponins caught on « koenami » are : *Melipona seminigra pseudocentris, M. rufiventris paraensis, M. scutellaris lateralis* and *Trigona cilipes*.

TABL. Ia. — *Floral resources for the genus* Melipona.

Table Ia. Floral resources for the genus Melipona. □ = data from notes of the museum collection, ■ = data by microscopical analysis, △ = data from field observations. Full scientific names are: M. captiosa Moure, M. compressipes (F.), M. favosa (F.), M. flavipennis Smith, M. illustris Schwarz, M. interrupta interrupta (Latr.), M. rufiventris paraensis (Ducke), M. scutellaris latitarsis (Erichson) and M. seminigra pseudocentris (Ckll.).



ACANTHACEAE	Acanthaceae spec.
ARALIACEAE	Didymopanax morototoni (Aubl.) Dcne. et Planch.
AVICENNIACEAE	Avicennia germinans L.
BORAGINACEAE	Cordia spec.
	Cordia curassavica Roem. et Sch.
	Cordia macrostachya (Jacq.) Roem. et Sch.
BURSERACEAE	Burseraceae spec.
CAESALPINIACEAE	Caesalpinia spec.
	Cassia spec.
	Cassia ramosa Vog. var. ramosa
CLUSIACEAE	Clusia spec.
COMPOSITAE	Compositae spec.
	Wedelia trilobata (L.) Hitchc.
CONVOLVULACEAE	Convolvulaceae spec.
CUCURBITACEAE	Momordica charantia L.
CYPERACEAE	Cyperaceae spec.
	Rhynchospora cephalotes Vahl
EUPHORBIACEAE	Ricinus communis L.
GRAMINAE	Graminae spec.
HUMIRIACEAE	Humiria balsamifera (Aubl.) St. Hil.
LYTHRACEAE	Lythraceae spec.
MALPIGHIACEAE	Byrsonima coriacea (Swartz) Kunth
MALVACEAE	Malvaceae spec.
MELASTOMATACEAE	Melastomataceae spec.
	Aciotis dichotoma (Benth.) Cogn.
MIMOSACEAE	Inga spec.
	Mimosa spec.
	Mimosa pudica L.
MORACEAE	Cecropia type
MYRTACEAE	Myrtaceae spec. 1
	Myrtaceae spec. 2
	Myrcia sylvatica (G.F.W. Mey.) DC.
	Syzygium cumini (L.) Skeels
OCHNACEAE	Sauvagesia sprengelii St. Hil.
OXALIDACEAE	Averrhoa carambola L.
PALMAE	Palmae spec.
	Cocos nucifera L.
	Elaeis guineensis Jacq.
PAPILLIONACEAE	Aeschynomene type
PEDALIACEAE	Sesamum indicum L.
PIPERACEAE	Piper poiteanum Kunth
PODOSTEMACEAE	Podostemaceae spec.
POLYGONACEAE	Polygonum acuminatum H.B.K.
	Triplaris surinamensis Cham.
PORTULACACEAE	Portulacaceae spec.
	Talinum spec.
PROTEACEAE	Panopsis type
ROSACEAE	Rosaceae spec.
RUTACEAE	Citrus spec.
SAPINDACEAE	Melicoccus bijugatus Jacq.
SAPOTACEAE	Sapotaceae spec.
SOLANACEAE	Solanum spec.
	Solanum stramoniifolium Jacq.
TILIACEAE	Waltheria americana L.
URTICACEAE	Urticaceae spec.
VERBENACEAE	Stachytarpheta spec.

TABL. Ib. — *Floral resources for true* Trigona.

Table Ib. Floral resources for true Trigona. □ and △ as in Table Ia. Full scientific names are: T. cilipes (F.), T. clavipes (F.), T. dallatorreana Friese, T. dorsalis beebei Schwarz, T. flavicornis (F.), T. fulviventris guianae Ckll., T. fuscipennis Friese, T. ghilianii (Spinola), T. handlirschi Friese, T. hyalinata branneri Ckll., T. jaty Smith, T. kaieteurensis Schwarz, T. lurida Smith, T. pallens (F.), T. recursa Smith, T. varia (Lep.) and T. williana Friese.

		T. cilipes	T. clavipes	T. dallatorreana	T. dorsalis b.	T. flavicornis	T. fulviventris g.	T. fuscipennis	T. ghilianii	T. handlirschi	T. hyalinata b.	T. jaty	T. kaieteurensis	T. lurida	T. pallens	T. recursa	T. varia	T. williana
ACANTHACEAE	Asystasia spec.														□			
ANNONACEAE	Annona spec.							□										
BEGONIACEAE	Begonia spec.						□								□			
BORAGINACEAE	Cordia spec.						□											
	Cordia macrostachya (Jacq.) Roem. et Sch.		△															
CAESALPINIACEAE	Cassia spec.		□															
	Cassia multijuga L.C. Rich.									□							□	
	Cassia ramosa Vog. var. ramosa														□			□
CLUSIACEAE	Clusia spec.								□					□				
COMPOSITAE	Clibadium surinamense L.	△																
	Vernonia remotiflora L.C. Rich.		□		□													
	Wulffia baccata (L.f.) Kuntze														□			
CONVOLVULACEAE	Convolvulus spec.						□								□			
CUCURBITACEAE	Momordica charantia L.																	□
CYPERACEAE	Cyperaceae spec.													□				
	Bulbostylis spec.													□				
GRAMINAE	Zea mays L.						△	△										
HUMIRIACEAE	Humiria balsamifera (Aubl.) St. Hil.		□															
LABIATAE	Hyptis spec.	□																
	Hyptis atrorubens Poit.		□				□					□						
LORANTHACEAE	Phoradendron piperoides (H.B.K.) Trelease	□									□							
MALPIGHIACEAE	Malpighiaceae spec.												□		□			
MALVACEAE	Hibiscus spec.										□							
MELASTOMATACEAE	Melastomataceae spec.						□	□										
MIMOSACEAE	Calliandra surinamensis Bth.										△							
	Neptunia plena (L.) Bth.						△											
MUSACEAE	Heliconia spec.																	□
	Musa spec.				□								□					□
MYRTACEAE	Myrcia sylvatica (G.F.W. Mey.) DC.													□				
ONAGRACEAE	Ludwigia leptocarpa (Nutt.) Hara						□											
PALMAE	Cocos nucifera L.			△							△							
	Hyospathe elegans Mart.						□								□			
	Orbignya spec.															□		
PASSIFLORACEAE	Passiflora spec.																	□
PAPILLIONACEAE	Phaseolus lunatus L.						△											
PEDALIACEAE	Sesamum spec.		□															
	Sesamum indicum L.										□			□				□
POLYGONACEAE	Coccoloba lucidula Benth.										□							
RUBIACEAE	Borreria capitata (R. et P.) DC.		□															
	Borreria latifolia (Aubl.) K. Sch.														□			
	Borreria ocimoïdes (Burm.) DC.	□					□										□	
	Retiniphyllum schomburgkii (Bth.) Müll. Arg.		□															
RUTACEAE	Citrus spec.		□															
SAPINDACEAE	Melicoccus bijugatus Jacq.					□		□			□							
SOLANACEAE	Solanum spec.						□											□
	Solanum melongena L.						△											
STERCULIACEAE	Melochia ulmifolia Benth.		□															
THEACEAE	Ternstroemia punctata (Aubl.) Sw.										□							
VERBENACEAE	Holmskioldia sanguinea Retz.		△				△											
VITACEAE	Cissus spec.		□															

The reference slide collection is still far from complete as nothing was known on the floral resources for stingless bees in Surinam. This is why a number of pollen types could only be identified to family or genus level. Nevertheless out of 43 pollen types only 7 could not be identified.

Plant taxa that are visited by bees of more than one genus are the Caesalpiniaceae, Clusiaceae, Melastomataceae, Palmae, Sesamum and Solanum. These taxa are

TABL. Ic. — *Floral resources for the other genera.*

Table Ic. Floral resources for the other genera. □ and △ as in Table Ia. Full scientific names are: Cephalotrigona capitata (Smith), Nannotrigona testaceicornis punctata (Smith), Oxytrigona obscura (Friese), Paratrigona impunctata (Ducke), P. peltata (Spinola), Plebeia minima (Gribodo), Scaura latitarsis (Friese), S. longula (Lep.) and S. tenuis (Ducke).

		Cephalotrigona capitata	Nannotrigona testac. p.	Oxytrigona obscura	Paratrigona impunctata	P. peltata	Partamona 1')	Partamona 3')	Plebeia minima	Scaura latitarsis	S. longula	S. tenuis
ACANTHACEAE	Asystasia spec.								□			
BEGONIACEAE	Begonia spec.							□				
CLUSIACEAE	Clusia spec.	□										□
HUMIRIACEAE	Humiria spec.	□										
LABIATAE	Hyptis spec.	□										
	Hyptis atrorubens Poit.					□						
	Orthosiphon grandiflorus Bold.								□			
LORANTHACEAE	Phoradendron piperoïdes (H.B.K.) Trelease						□					
MALPIGHIACEAE	Byrsonima spec.					□						
MIMOSACEAE	Inga spec.			□								
PALMAE	Astrocaryum paramaca Mart.			□								
	A. sciophyllum (Miq.) Pulle			□								
	Cocos nucifera L.									△		
PEDALIACEAE	Sesamum indicum L.	□										
RUBIACEAE	Borreria spec.		□									
	Borreria latifolia (Aubl.) K. Sch.	□										
SOLANACEAE	Solanum spec.						□					
VITACEAE	Cissus spec.									□		

') concerns two distinctly different Partamona species that still have to be identified.

probably important floral resources for stingless bees in general. There are too few data to split them on (bee) species level, but a comparison between the largest two genera, Melipona and Trigona (Tables I*a* and I*b*) has been made. Data from the pollen analysis were exclused from this comparison, as samples were taken in different vegetation types (savannah and coastal area). On the following taxa more than one Trigona species was caught, but never a Melipona : Begoniaceae, Hyptis, Loranthaceae, Musaceae and Rubiaceae. On *Ludwigia leptocarpa* (Onagraceae), *Ricinus communis* (Euphorbiaceae) and Cissus spec. (Vitaceae) only one Trigona species was caught and no Melipona. Being incidental observations, these data have to be regarded with reserve. On the other hand the Podostemaceae, Portulacaceae (visited by resp. 3 and 2 Melipona species), the Burseraceae, Sauvagesia sprengelii (Ochnaceae) and Piperaceae (all visited by one Melipona) are absent on the list of the Trigona (Table I*b*).

The results of the microscopical analysis of the pollen samples of *Melipona favosa* (23 samples) are shown quantitavely in Table II. Frequency classes of the pollen types are large : incidental pollen (less than 5 %), frequent pollen (5-30 %) and abundant pollen (over 30 %). This was done as the material in the pollen pots is not homogenized and only small samples could be taken. Most important pollen yielders

for *M.favosa* are : *Avicennia germinans, Aciotis dichotoma,* Myrtaceae spec., *Polygonum acuminatum* and Solanum spec.

TABL. II. — *Number of samples of* Melipona favosa (F.) *containing pollen of plant species within each frequency class.*

Table II.
Number of samples of Melipona favosa (F.) containing pollen of plant species within each frequency class. Frequency classes: incidental pollen (less than 5%), frequent pollen (5 - 30%) and abundant pollen (over 30%). N = 23.

		Incidental pollen	Frequent pollen	Abundant pollen
ARALIACEAE	Didymopanax morototoni (Aubl.) Dcne. et Planch.		3	1
AVICENNIACEAE	Avicennia germinans L.	6	2	5
BORAGINACEAE	Cordia macrostachya (Jacq.) Roem. et Sch.	1		
CAESALPINIACEAE	Caesalpinia spec.	3		
COMPOSITAE	Compositae spec.	9	1	
CUCURBIATACEAE	Momordica charantia	2	1	1
CYPERACEAE	Cyperaceae spec.	2	1	
GRAMINAE	Graminae spec.	3	1	
HUMIRIACEAE	Humiria balsamifera (Aubl.) St. Hil.	1	1	
LYTHRACEAE	Lythraceae spec.	1		1
MALPIGHIACEAE	Byrsonima coriacea (Swartz) Kunth	4	2	
MALVACEAE	Malvaceae spec.	1		
MELASTOMATACEAE	Melastomataceae spec.	2		
	Aciotis dichotoma (Benth.) Cogn.	2		4
MIMOSACEAE	Inga spec.	1		
	Mimosa spec.	1	1	1
	Mimosa pudica L.	2	3	1
MORACEAE	Cecropia type	1		
MYRTACEAE	Myrtaceae spec.	2		5
	Syzygium cumini (L.) Skeels	1	1	2
PALMAE	Palmae spec.	6	1	1
PAPILLIONACEAE	Aeschynomene type			1
POLYGONACEAE	Polygonum acuminatum	5	1	3
PROTEACEAE	Panopsis type	1	2	
SAPOTACEAE	Sapotaceae spec.	1		
SOLANACEAE	Solanum spec.	5	1	7
	Solanum stramoniifolium Jacq.			1
URTICACEAE	Urticaceae spec.	2		

DISCUSSION

Meliponinae are social bees that have to maintain a broodnest the whole year round. They are generalists in their food choice as they cannot afford to be oligolectic. However some specialisation must occur as more species can coexist in the same habitat albeit that to some extent they have an overlap in their floral resources. How these specialisations are induced and manifested is hard to say. Preference for a flower syndrome, time of forage activity, interspecific aggression and recruitment techniques will all play a role. As we have so little data for each bee-species on its floral resources nothing can be said on their preference for a certain flower syndrome. Our data do not contain information on the other aspects. Size of the visiting bee will also play a role : nectar and/or pollen of very small flowers, or flowers with a long and narrow corolla will be inaccessible for larger bees if they try to obtain it in a legitimate way. The body sizes of the bees range between 2 mm (*Plebeia minima*) and 13.5 mm (*Melipona flavipennis*). The bees were divided in two size classes, and the data were considered again. Most data concern the larger bees :

Melipona, most Trigona and *Cephalotrigona capitata*. The smallest bees are *Plebeia minima*, the Paratrigona species and *Trigona jaty*. Only on some plants small, but no large bees were caught. These are Asystasia spec. (Acanthaceae), which has a long and narrow corolla, and *Orthosiphon grandiflorus*, a Labiatae. On the other hand large bees were caught on some small flowers like Hyptis (Labiatae) and Borreria (Rubiaceae). On some flowers large numbers of bees belonging to the larger size class were caught. Even considering the fact that more data are available on the larger than on smaller bees the absence of the latter is striking. The flowers in question are : Solanum, *Melicoccus bijugatus* and *Sesamum indicum*. Solanum has anthers with terminal pores and may rely solely on « buzz pollination » (like some Caesalpiniaceae; BUCHMANN, 1974; ANZENBERGER, 1977). By hanging over to pores and vibrating the pollen is loosened and shoots out of the pore onto the body of the bee. Slighter bees may not succeed in loosening the pollen in this way. No suggestion can be made for the absence of smaller bees on *Melicoccus bijugatus* and *Sesamum indicum*.

In Table I*a* can be seen that data by microscopical analysis (black squares) rather add new plant species to the list than confirm the data found on the accompanying notes of the museum collection (open squares). The main reason for this is the fact that sampling was done in different vegetation types : the savannah and the coastal area.

The articles of DUCKE (1901, 1902) are on flower visits of Meliponinae in Parā (Brazil); the data of ABSY and KERR (1977) and IWAMA and MELHEM (1979) are obtained by microscopical analysis. We applied both these techniques : observations of flower visits and microscopical analysis. Though dealing with different plant and bee species, a general comparison can be made. Of the Papillionaceae, which are well represented in Surinam (AMSHOFF, 1939), only one species has been found in the pollen samples (Aeschynomene type) and only one flower visit has been observed (*Trigona fulviventris guianae* on *Phaseolus lunatus*). DUCKE (1901, 1902) recorded 9 Melipona species visiting four different Papillionaceae. But the Palmae, Boraginaceae and Myrtaceae are missing on his list. Absence of palms may be caused by the fact that catching bees in palms is not very easy. The Boraginaceae and Myrtaceae on the other hand are shrubs and treelets with a cosmopolitic distribution and a distribution in the Tropics and Australia.

In both ABSY and KERR (1977) and IWAMA and MELHEM (1979) the Euphorbiaceae are represented by more than one species. This is not surprising as most Euphorbiaceae are abundant pollen producers. Only one species, *Melipona rufiventris paraensis*, was caught while visiting an Euphorbiaceae, but no pollen of this family is found in the samples.

The Polygonaceae, in our case *Polygonum acuminatum* and *Triplaris surinamensis*, are not mentioned in any of the other four articles.

Received for publication in May 1980.

ACKNOWLEDGEMENTS

We are indebted to Mr. K. van DEURSEN for his help. The Ministry of Agriculture, Husbandry and Fisheries in Surinam kindly offered their transport facilities. We would like to thank Dr. H. H. W. VELTHUIS and Dr. W. PUNT for their valuable support during this research. This study was made possible by a grant from the Treub Maatschappij, Utrecht.

RÉSUMÉ

LES RESSOURCES EN NECTAR ET POLLEN POUR LES MÉLIPONES (MELIPONINAE, HYMENOPTERA) AU SURINAM (AMÉRIQUE DU SUD)

Cette étude a trait aux ressources florales exploitées par les mélipones au Surinam. Les informations proviennent des notes jointes aux abeilles de la collection du Museum à Leiden, de l'analyse des échantillons de miel et de pollen pris dans les nids et des pelotes de pollen prélevées sur les abeilles butineuses et enfin des observations faites en champ.

Les connaissances sur ce sujet sont très peu nombreuses, bien qu'il existe de la bibliographie sur les ressources florales pour les mélipones d'Amérique du Sud hors du Surinam.

On a récolté des données pour 37 espèces sur 60 de mélipones connues au Surinam. Elles sont regroupées dans les tableaux I *a*, *b* et *c*. Bien que ces données ne fournissent qu'une image fragmentaire, on peut conclure que les Caesalpiniaceae, les Clusiaceae, les Melastomataceae, les Palmae, *Sesamum* et *Solanum* sont des taxons importants pour ces abeilles, puisqu'ils sont visités par plusieurs espèces.

Si l'on compare les genres *Melipona* (Tabl. I *a*) et *Trigona* (s.s.) (Tabl. I *b*), on voit les différences suivantes : seules les espèces *Melipona* visitent les Podostemaceae et les Portulacaceae, tandis que les espèces *Trigona* ont seules été observées sur les Begoniaceae, *Hyptis*, les Loranthaceae, les Musaceae et les Rubiaceae.

Pour *M. favosa*, espèce pour laquelle on a obtenu de nombreux échantillons, les plantes butinées les plus importantes sont *Avicennia germinans, Aciotes dichotoma, Syzygium cumini, Polygonum cuminatum* et les espèces *Solanum*.

On rapporte ici pour la première fois l'existence de pollen récolté par les mélipones sur les Polygonaceae.

ZUSAMMENFASSUNG

NEKTAR- UND POLLENQUELLEN DER STACHELLOSEN BIENEN (MELIPONINAE, HYMENOPTERA) IN SURINAM (SÜD-AMERIKA)

In dieser Untersuchung werden Informationen über die Blütentracht gegeben, welche die Stachellosen Bienen in Surinam ausnutzen. Die Informationen wurden aus den Notizen gewonnen, die sich an den Bienen der Sammlung im Museum von Leiden befanden, ferner durch Analyse von Honig- und Pollenproben aus den Nestern und von Pollenhöschen an Sammelbienen sowie durch Feldbeobachtungen.

Obwohl es einige Publikationen über die Trachtquellen von Stachellosen Bienen Südamerikas ausserhalb von Surinam gibt, sind die Kenntnisse auf diesem Gebiet äusserst spärlich.

Es wurden Daten über 37 von den 60 Arten Stachelloser Bienen gewonnen, die in Surinam vorkommen. Sie sind in den Tabellen I*a*, *b* und *c* zusammengestellt. Obwohl diese Daten nur ein fragmentarisches Bild vermitteln, kann man daraus doch den Schluss ziehen, dass die Caesalpiniaceae, Clusiaceae, Melastomataceae, Palmae, *Sesamum* und *Solanum* wichtige Gruppen für diese Bienen darstellen; sie werden jeweils von mehreren Bienenarten besucht.

Beim Vergleich der Bienengattungen *Melipona* (Tab. I*a*) und *Trigona* (s.s.; Tab. I*b*) erkennt man die folgenden Unterschiede : Nur die *Melipona-Arten* besuchen die Blüten der Podostemaceae und Portulacaceae, während für die Begoniaceae, *Hyptis*, Loranthaceae, Musaceae und Rubiaceae nur *Trigona*-Arten angeführt sind.

Für *Melipona favosa*, von welcher Art viele Proben untersucht wurden, sind *Avicennia germinans, Aciotes dichotoma, Syzygium cumini, Polygonum acuminatum* und *Solanum*-Arten die wichtigsten Trachtpflanzen.

Dass Stachellose Bienen Pollen von Polygonaceae sammeln, wird hier zum ersten Mal berichtet.

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Note added in proof : the *Partamona* species 1 and 3 from Table 1c have been ascertained to be *P. cupira* (Smith) and *P. musarum* (Ckll) respectively.