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AN OVERVIEW OF THE CARAMBOLA FRUIT FLY
BACTROCERA SPECIES (DIPTERA:TEPHRITIDAE),
FOUND RECENTLY IN SURINAME.

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ABSTRACT

The identification of a species of *Bactrocera* (formerly *Dacus*) in Suriname in 1986 resulted in a survey to obtain information on the host plants of this fruit fly and its geographical distribution. During four years, 77 plant species were collected to obtain fruit flies infesting those fruits and Jackson traps were set to collect adults. Only one *Bactrocera* species and several *Anastrepha* species were reared from fruits. The Carambola fruit fly was found in 15 plant species and flies were trapped from the eastern border up to 56° 30' longitude west in the Coronie district; to the south up to the Brokopondo Lake and southwest isolated along the western border with Guyana.

RESUMEN

A raíz de la identificación de una especie de *Bactrocera* (conocida antes como *Dacus*) en Surinam en 1986, se inició un muestreo para obtener información sobre las plantas hospederas y la distribución geográfica de la mosca. Durante 4 años se colectaron 77 especies de plantas y se utilizaron trampas Jackson con el fin de atrapar adultos. Únicamente un adulto de *Bactrocera* y varias especies de *Anastrepha* emergieron de las frutas colectadas. La mosca de la carambola se encontró en 15 especies de plantas y las moscas fueron atrapadas desde el límite oriental, hasta la latitud 56° 30' oeste en el distrito Coronie, y desde el sur hasta el lago Brokopondo y en el sureste a lo largo del límite oeste con Guyana.

The Carambola fruit fly is a species of the genus *Bactrocera* that has been introduced into Suriname. It is part of a complex of some 44 species, known as the *dorsalis* complex (R.A.I. Drew, pers. comm.). This species is endemic to Indonesia, Malaysia and Southern Thailand. The Carambola fruit fly has not been formally described, although Drew & Hancock (in prep.) will soon provide a scientific name. The Carambola fruit fly in Suriname was originally misidentified as *Dacus dorsalis* (Hendel); this and other *Bactrocera* species were until recently included within the genus *Dacus* (Drew 1989). It has also been referred to as *Dacus* sp. No true *Dacus* (sensu Drew 1989) occur in the New World.

Until 1986 there were no published records of Dacini (*Dacus* or *Bactrocera* spp.) occurring in Central or South America. Recent infestations of the Oriental fruit fly, *Bactrocera dorsalis* (Hendel) in California and the Mariana Islands (USA) have been eradicated (Stibick 1989).

The larvae of the fruit flies in the *dorsalis* complex have been recorded in at least 150-236 different hosts (Weems 1964, Stibick 1989), as well in fruits as in vegetables; at that time all were considered to be the Oriental fruit fly. No information on specific host plants for the different species in the complex is yet available.

HISTORY OF THE DETECTION OF CARAMBOLA FRUIT FLY IN SURINAME

In 1975 a few Carambola fruit flies were reared from curacao (or java) apple (*Syzygium samarangense*, syn. *Eugenia javanica*). These flies were pinned and placed in the insect collection of the Agricultural Experiment Station in Paramaribo where they remained unidentified.

In December 1981, more Carambola fruit flies were reared from curacao apples, bought at the Central Market in Paramaribo. A sample of adults was sent to the Insect Identification Center in Beltsville, Maryland, and identified as *Dacus* sp. probably *D. dorsalis*. They were brought to the attention of the Surinamese Ministry of Agriculture, because no Dacini are native and if a species has been introduced, additional collections should be made. However the importance of a species of Dacini possibly existing in South America was not recognized at that time and therefore no additional fruit collections were made.

In March 1986, some Carambola fruit fly adults were reared from guava (*Psidium guajava*) and sapodilla fruits (*Manilkara zapota*). These fruit flies showed a close resemblance to the depicted species of *Dacus dorsalis* in the Entomology Circular (Weems 1964). Specimens were sent by the author to the Insect Identification Center in Beltsville, together with some specimens collected in 1975. These fruit flies were identified on July 31, 1986, by Dr. A. L. Norrbom, USDA-ARS, as *Dacus dorsalis* (Hendel). Drew (1989) revised the Dacinae of the Australasian Region and transferred many of the species, including *dorsalis* (Hendel), to the genus *Bactrocera*. It has been determined by R.A.I. Drew (Entomology Branch, Queensland Department of Primary Industries, Australia), that *Bactrocera dorsalis* actually is a complex of species, occurring in South East Asia, of which several species are as yet undescribed. Drew and Hancock have examined Surinamese specimens and determined that the flies belong to one of these undescribed species (Drew & Hancock, personal communication). It is proposed by these authors that the Surinamese *Bactrocera* species be called the Carambola fruit fly.

This species is endemic to Indonesia, Malaysia and Southern Thailand. The origin of the Carambola fruit fly in Suriname is not known.

The human population of Suriname is very heterogenous; an important part (50%) originates from Asian countries such as India, Indonesia and China. Because of these historical ties there still is much traffic between these nations and Suriname. The introduction of the Carambola fruit fly by trade or tourists from Indonesia to Suriname is the most probable hypothesis.

Situation and Climate

Suriname is situated on the north coast of South America, between 2° and 6° north latitude and from 54° to 58° west longitude. The total area is 163,820 sq. km.

Suriname has a tropical climate with daily temperatures ranging from 27° to 33°C. The mean annual rainfall ranges from 2200 to 2400 mm in the South East. The country is still covered with native forest (90.6%), the majority of which is mesophytic forest. Only about 3% of the land area is cultivated (including abandoned plantations).

Survey

After the identification of the Carambola fruit fly in 1986, a survey was started by the Experimental Station of the Ministry of Agriculture of Suriname to gain information on its geographical distribution and host plants. Fruits were collected from March 1986 to June 1990 and McPhail and Jackson traps baited with methyl-eugenol were installed from October 1987.

Fruit collections

From March 1986 to June 1990, 1303 samples were taken of 77 plant species. The samples contained one to 30 or more fruits, depending on fruit tree species and fruit availability. The fruits were placed on sterilized soil or on sawdust in plastic containers, covered with paper to prevent secondary infections. Pupae were collected every 2-3 days and placed in small jars containing sterilized soil/sawdust. These were held until adults emerged at a temperature of 27°-32°C and a humidity of 80-95%. The total fruit collections and fruit flies reared from each sample are presented in Table 1 and 2. The most important hosts of the Carambola fruit fly in Suriname are Curacao apple (*Syzygium samarangense*) and the sweet variety of carambola (*Averrhoa carambola*); other hosts are star apple (*Chrysophyllum cainito*), sapodilla (*Manilkara zapota*), mango (*Mangifera indica*), West-Indian cherry (*Malpighia puniceifolia*) and guava (*Psidium guajava*). Minor hosts are cashew (*Anacardium occidentale*), malay apple (*Syzygium malaccensis*), Indian jujube (*Zizyphus jujuba*), surinam cherry (*Eugenia uniflora*), tropical almond (*Terminalia catappa*), orange (*Citrus sinensis*), grapefruit (*C. paradisi*) and mandarin (*C. reticulata*). The only species of Dacini found was the Carambola fruit fly. Many *Anastrepha* spp. were reared, but no *Ceratitis capitata* were found.

All host fruits are cultivated; no wild fruits were infested. Six of the host fruits originate from Central America, South-America or the Caribbean.

Trapping

Trapping was started in October 1987 with 10 plastic McPhail traps, baited with 4 ml methyl-eugenol in the top of the trap and a water/soap mixture in the basal part of the trap. All traps were placed in major or minor host trees (based on fruit collections) in Saramacca and Wanica (from Paramaribo up to 80 km west), an area where the Carambola fruit fly occurs. In May 1988, 23 plastic McPhail traps were installed in Coronie, Nickerie, Para and Brokopondo, an area where the Carambola fruit fly was unknown. The plastic McPhail traps were replaced by Jackson traps from June to April 1989. The majority of Jackson traps were installed after August 1989, when transport was made available for the project. A total of 484 traps were installed in the coastal area and in the interior by June 1990. The traps were serviced every two weeks up to once a month, sometimes longer.

TABLE 1. FRUIT COLLECTIONS IN SURINAME.

Family	Scientific Name	Common Name	Origin	Number of			No. of samples with				Samples No. FF
				Sites	Samples	Fruits	Bactro	B/A	Anast		
Anacardiaceae	<i>Anacardium occidentale</i>	cashew	N	8	16	132	0	1	2	13	
	<i>Mangifera indica</i>	mango	I	16	61	427	10	0	0	50	
	<i>Spondias cytherea</i>	golden apple	I	10	27	225	0	0	1	26	
	<i>Spondias mombin</i>	hogplum	N	9	29	745	0	0	26	3	
Annonaceae	<i>Annona montana</i>	mountain soursop	N	2	5	17	0	0	0	5	
	<i>Annona muricata</i>	soursop	N	13	20	29	0	0	0	19	
	<i>Annona reticulata</i>	custard apple, bullock's heart	N	4	9	38	0	0	0	9	
	<i>Annona</i> sp.		N	1	1	7	0	0	0	1	
Apocynaceae	<i>Stemmadenia grandiflora</i>		N	1	1	5	0	0	0	1	
Avicenniaceae	<i>Avicennia germinans</i>	parwa	N	1	1	107	0	0	0	1	
Bignoniaceae	<i>Pseudocalymna alliaceum</i>	knoflookliaan	N	1	1	2	0	0	0	1	
Bromeliaceae	<i>Ananas comosus</i>	pineapple	N	2	3	4	0	0	0	3	
Burseraceae	<i>Canarium commune</i>	kenari root	I	1	1	69	0	0	0	1	
Caesalpinjiaceae	<i>Inocarpus edulis</i>	cajam	I	1	3	23	0	0	0	3	
	<i>Tamarindus indica</i>	tamarind	I	2	2	10	0	0	0	2	
Campanulaceae	<i>Centropogon cornutus</i>		N	1	1	12	0	0	0	1	
Cariaceae	<i>Carica papaya</i>	papaya	N	7	12	34	0	0	0	12(1)*	
Combretaceae	<i>Terminalia catappa</i>	tropical almond	I	6	16	183	1	0	0	15	
Convolvulaceae	<i>Ipomoea</i> sp.		N	1	1	?	0	0	0	1	
Dilleniaceae	<i>Dillenia indica</i>	olifantsappel	I	1	5	33	0	0	0	5	
Euphorbiaceae	<i>Manihot esculenta</i>	cassava	N	3	12	+618	0	0	8	4	
	<i>Phyllanthus acidus</i>	gooseberry	I	6	6	+304	0	0	0	6	
	<i>Ricinus communis</i>		I	1	4	+480	0	0	0	4	
Flacourtiaceae	<i>Flacourtia jangomas</i>	'babygrape'	I	5	5	+132	0	0	0	5	
Guttiferaceae	<i>Garcinia dulcis</i>	moendoe	I	2	2	18	0	0	0	2	
Hypericaceae	<i>Vismia cayennensis</i>	pinja	N	1	1	57	0	0	0	1	
Lauraceae	<i>Persea americana</i>	avocado	N	3	3	11	0	0	0	3	
Leguminosaceae	<i>Inga</i> sp.		N	5	8	133	0	0	1	7	

TABLE 1. (Continued)

Family	Scientific Name	Common Name	Origin	Number of					No. of samples with				Samples No. FF
				Sites	Samples	Fruits	Bactro	B/A	Anast				
Malpighiaceae	<i>Malpighia punicifolia</i>	West-Indian cherry	N	30	108	+2719	7	12	28				61
Malvaceae	<i>Hibiscus tiliaceus</i>	maho	N	1	1	19	0	0	0				1
Melastomataceae	<i>Bellucia</i> sp.	mispel	N	1	2	7	0	0	0				2
	<i>Miconia ciliata</i>	mispel	N	1	1	?	0	0	0				1
	<i>Miconia</i> sp.	mispel	N	1	1	115	0	0	0				1
	<i>Miconia</i> spp.	mispel	N	4	4	162	0	0	3				1
Moraceae	<i>Cecropia sciadophylla</i>	'bospapaya'	N	1	1	54	0	0	0				1
Musaceae	<i>Musa paradisiaca/ sapientum</i>	banana	N	1	2	4	0	0	0				2
Myrtaceae	<i>Syzygium cumini</i>	java plum, jambolan	N	9	13	+305	0	0	0				13
	<i>Syzygium jambos</i>	rose apple	I	1	1	3	0	0	0				1
	<i>Syzygium malaccensis</i>	pomerac, malay apple	I	9	13	181	1	1	1				10
	<i>Syzygium samarangense</i> ¹	curacao apple, java apple	I	35	144	2929	16	35	24				6
Oxalidaceae	<i>Eugenia uniflora</i>	Surinam cherry, pitanga	N	2	3	+9	0	1	0				2
	<i>Psidium guajava</i>	guava	N	43	166	+1195	0	19	111				29
	<i>Averrhoa bilimbi</i>	bilimbi	I	11	18	+150	0	0	0				18
	<i>Astrocaryum carambola</i>	carambola, star fruit	I	33	137	1097	57	10	3				67
	<i>Bactris</i> sp.	'awara' palm	N	2	5	29	0	0	0				5
	<i>Guiljelma (Bactris) gasipaes</i>	keskesmaka	N	1	1	52	0	0	0				1
	<i>Macmilliana maripa</i>	paripoe	N	2	3	76	0	0	0				3(2)*
		Chinese awara	N	1	3	95	0	0	0				3
		waiierpalm	I	1	1	18	0	0	0				1
			I	1	1	?	0	0	0				1
Passifloraceae	<i>Ptychosperma macarthurii</i>		I	1	1	62	0	0	0				1
	<i>Passiflora edulis</i>	passionfruit,markoesa	N	2	2	19	0	0	0				2
	<i>Passiflora ligularis</i>	sneki markoesa	N	3	5	203	0	0	0				5
	<i>Passiflora quadrangularis</i>		N	1	1	6	0	0	0				1

Polygoniaceae	<i>Passiflora vespertillo</i>	N	1	1	6	0	0	0	0	1
Punicaceae	<i>Coccoloba uvifera</i>	I	1	1	118	0	0	0	0	1
Rhamnaceae	<i>Punica granatum</i>	I	2	7	13	0	0	0	0	7
Rubiaceae	<i>Zizyphus jujuba</i>	I	11	21	832	3	0	2	2	27
	<i>Coffea</i> spp.	I	1	2	150	0	0	0	0	2
	<i>Geophyla herbaceae</i>	N	1	1	108	0	0	0	0	1
	<i>Sabiceae glabrescens</i>	N	1	1	102	0	0	0	0	1
	<i>Citrus aurantifolia</i>	I	3	4	90	0	0	0	0	4
	<i>Citrus aurantium</i>	I	2	2	13	1	0	0	0	1
	<i>Citrus maxima</i>	I	2	3	5	0	0	0	0	3
	<i>Citrus medica</i>	I	1	12	55	0	0	0	0	12
	<i>Citrus paradisi</i>	I	10	50	581	1	3	2	2	44
	<i>Citrus reticulata</i>	I	17	35	+186	2	0	1	1	32
	<i>Citrus sinensis</i>	I	30	163	1853	2	0	2	2	159(8)*
	<i>Citrus paradisi</i> *reticulata	I	2	4	5	0	0	0	0	4
	<i>Triphasia trifolia</i>	I	2	4	266	0	0	0	0	4
Sapindaceae	<i>Bligh's sapida</i>	I	2	2	20	0	0	0	0	2
	<i>Paullinia pinnata</i>	N	3	4	241	0	0	0	0	4
Sapotaceae	<i>Chrysophyllum cainito</i>	N	13	29	167	1	4	14	13	13
	<i>Lucuma nervosa</i>	N	1	1	8	0	0	0	0	1
	<i>Manilkara zapota</i> ²	N	18	46	216	0	4	18	23	23
	<i>Pouteria macrophylla</i>	N	1	3	48	0	0	0	0	3(1)*
Verbenaceae	<i>Citharexylum</i> sp.	N	2	2	+435	0	0	0	0	2

¹synonym of *Eugenia javanica*;

²*Manilkara zapota* = *Achras zapota*.

³N = native to Central and South America and the Caribbean,

I = introduced species;

() * number in brackets: samples with dead maggots or pupae, not necessarily fruit flies.

The traps were installed in apple or carambola trees. If these were not available, minor host trees were used. No trap rotation was executed.

High densities of Carambola fruit flies (up to 800/month/Jackson trap) have been encountered in populated areas in the districts Paramaribo, Wanica, Saramacca, Comewijne, Para and Coronie; lower numbers (about 1/month/Jackson trap) were found in the districts Sipaliwini and Brokopondo.

GEOGRAPHICAL DISTRIBUTION

The results of fruit sampling and trapping are shown in Fig. 1. The Carambola fruit fly has been recovered in Albina; about 150 km east of Paramaribo, near the border with French-Guyana, by fruit sampling. To the west it has been found by trapping, about 142 km west of Paramaribo. To the southwest flies have been found by fruit sampling and trapping about 90 km from the capital and along this same road, in Apura at the Corantyn River, 7 flies were recovered by trapping. In the south, about 90 km from Paramaribo, 16 flies were recovered by trapping. No recent information is however available, due to reasons of safety.

DISCUSSION

The Carambola fruit fly originates from Indonesia, Thailand and Malaysia (pers. com. D. L. Hancock, Entomology Branch, Queensland Department of Primary Industries, Australia). One of its major host plants in these countries is the carambola, as in Suriname. The other major host plant in Suriname, the Curacao apple, also originates from southeast Asia. No information is available on the species of *Bactrocera* infesting this fruit tree in Asia. The true *B. dorsalis*, which, according to Dr. Drew, occurs in Hawaii, has as major host plants avocado, banana, coffee, guava, mango, mountain apple, papaya, rose apple and Surinam cherry (Bess & Haramoto 1961). No fruit fly infestation is known to occur in Suriname from rose apple, bananas, avocado, papaya and coffee, however only a few samples were taken during this research. Tropical almond and Surinam cherry are minor hosts; only guava and mango have a higher infestation, but are certainly not major hosts. *A. carambola* and *S. samarangense* both support only a light infestation of *Anastrepha obliqua*. These results agree with research executed in Brazil (Malavasi et al. 1980), where only a very light infestation of carambola by *Anastrepha* spp. is found.

CONCLUSIONS

The difference in host preference between the Carambola fruit fly in Suriname and the *B. dorsalis* in Hawaii support the hypothesis that the many widespread fruit fly populations that had been recognized as *B. dorsalis* are not one species as was supposed until a few years ago, but a complex of species.

As the Carambola fruit fly is now introduced on the mainland of South America, the feasibility of eradication must be reexamined. Special attention should be paid to wild fruits, because if the Carambola fruit fly breeds in these fruits, eradication would not seem feasible. In that case biological control might be a more promising approach. The egg-larval parasite *Biosteres arisanus* (Sonan) (formerly *Opius oophilus*), which was introduced in Hawaii in 1947 from Malaysia (Clausen et al. 1965) or the parasite *Diachasmimorpha longicaudata* (formerly *Opius longicaudatus*) could prove successful.

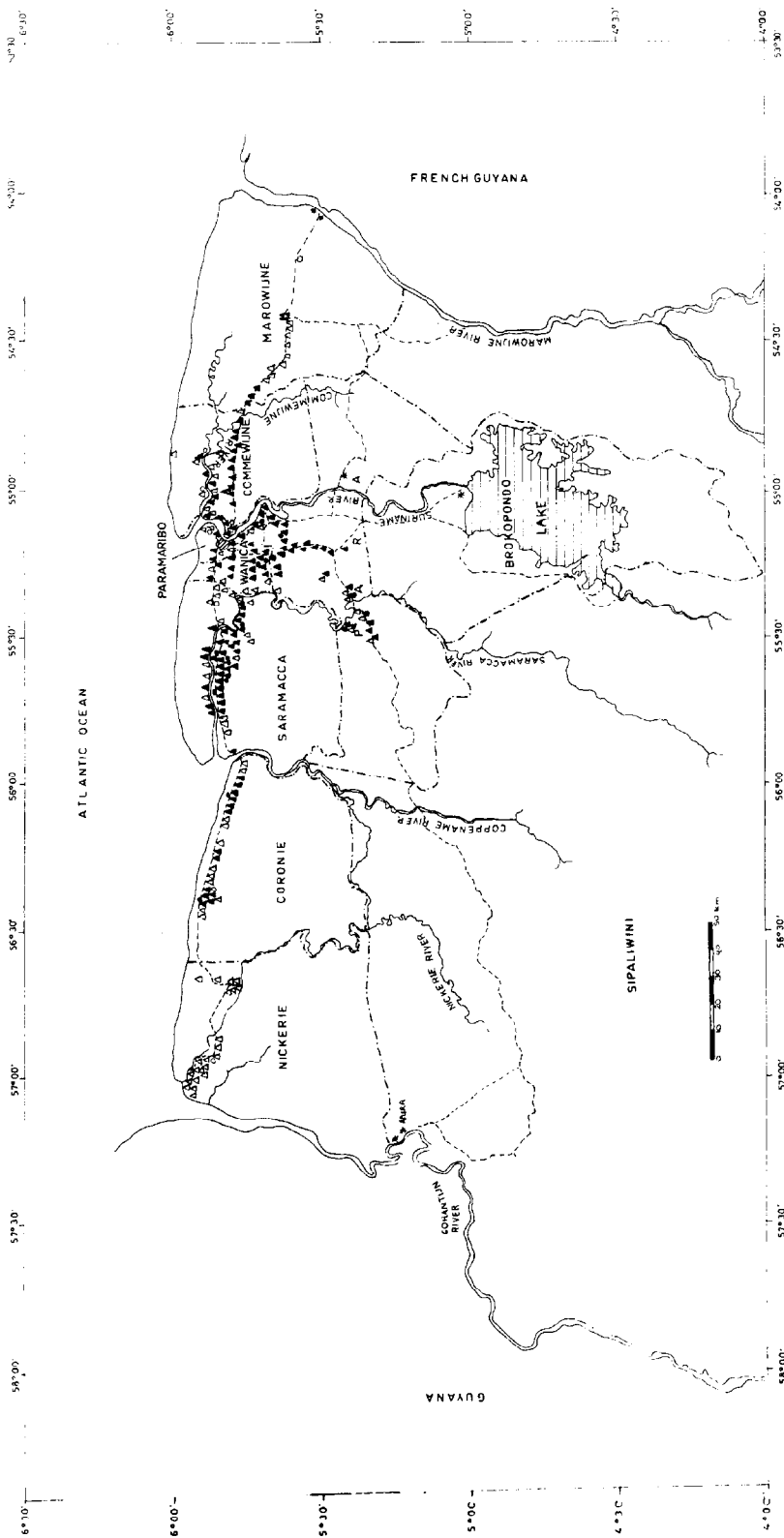


Fig. 1. Map of Northern Suriname, showing distribution of the Carambola fruit fly, *Bactrocera* sp. May 31, 1990.

Fig. 1. Legend

- fruit collected, no Carambola fruit fly found
- fruit collected, Carambola fruit fly found
- △ trap location, no Carambola fruit fly present
- △ trap location, Carambola fruit fly present
- * location with Carambola fruit fly, no recent data
- road
- ... district border

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USE OF LEAF DOMATIA ON WILD GRAPE (*VITIS
MUNSONIANA*) BY ARTHROPODS IN CENTRAL FLORIDA

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ABSTRACT

Pocket-like domatia on the underside of the leaves of wild grape, *Vitis munsoniana* Simpson, were occupied by fungivorous (47.0%), predatory (7.8%), and rarely herbivor-

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