Release and establishment in Nigeria of *Epidinocarsis lopezi*, a parasitoid of the cassava mealybug, *Phenacoccus manihoti*

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Abstract

The encyrtid wasp *Epidinocarsis* (= *Apoanagyrus*) *lopezi* (De Santis) was imported from Paraguay into Nigeria for the biological control of the cassava mealybug, *Phenacoccus manihoti* Matile-Ferrero. It was mass-reared and released at four localities in Nigeria. The parasitoid is now established and it is dispersing throughout cassava growing areas of Nigeria.

Introduction

The cassava mealybug, *Phenacoccus manihoti*, is a serious pest in Africa, introduced from Latin America. It attacks and destroys cassava (*Manihot esculenta* Crantz) causing tuber yield losses of up to 54% and 84% for early and late planted cassava, respectively (Nwanze, 1982) and up to 100% loss of foliage which is used as vegetable in several countries in Africa.

A biological control program against this pest was started in 1980 at IITA to complement the research on host plant resistance that has been going on for the last 4 years. The parasitoid *Epidinocarsis lopezi* was discovered in Paraguay by Dr. M. Yaseen, an entomologist from the Commonwealth Institute of Biological Control (CIBC), Trinidad. It was imported into Nigeria on July 31, 1981 through the quarantine services of the C.I.B.C. in London. The rearing program started at the International Institute of Tropical Agriculture (IITA) thereafter by the senior author who also released the parasitoids in several localities in Nigeria. This paper reports the establishment and dispersal of the parasitoid. A subsequent paper will report on the results related to the effectiveness of the parasitoid in regulating its host populations.

Materials and methods

Mass-rearing and releases. Parasitoids were mass reared on the mealybugs in 58 cm × 44 cm × 42 cm wooden cages with double sleeves. Potted cassava plants infested with nymphs were placed in each cage where the parasitoids were introduced. The releases were made in marked release sites throughout selected fields. Each release site consisted of two to four adjacent cassava plants infested with mealybug nymphs. Three to 16 sites were set throughout each release field.

The parasitoids were collected from the rearing cages and released on the same day in the IITA field. If releases were done farther away, the wasps were collected the day before and preserved in vials with honey. The releases were made between November 1981 and December 1982 at four localities: IITA and Ilora in Oyo State, the Texaco Farm at about 15 km north of Abeokuta in Ogun State and at Aguleri-Atu in Anambra State (Fig. 1).

Texaco Farm is a plantation of 2 430 ha with 1 703 ha of cassava in one more or less continuous field. At that farm, a 2-ha plot was staked out for the release. The releases occurred as follows: (1) potted plants with *E. lopezi* in parasitized bugs were collected from the rearing cages and two or three plants were placed at each release site. This method

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was used at IITA and on the Texaco Farm during the initial releases when mealybug populations were too low to provide enough oviposition sites and food for the parasitoids; (2) adult parasitoids were released either in small numbers (50 ♀♀ and several ♂♂ per site) every other week or once in larger numbers (700–1 500 per field).

Description of release localities. These localities occur in the major cassava growing area of the country. The vegetation consists, from the south to the north, of the swamp forest (mangrove) along the coast, moist lowland forest, forest-savannah mosaic, dry forest and mixed leguminous wooden savannah (Anon., 1978). Annual rainfall (April/May to November/December) varies between 500 mm and 4 000 mm with a short dry spell in August (Anon., 1978).

Recovery of the parasitoid. Parasitoid (and mealybug) populations were monitored in the release fields at IITA and Texaco Farm, starting 2 weeks after the first release, by bi-weekly collection of samples of cassava tips (about 10 cm of the topmost portion of the plant) where the bugs occur most frequently. After the release field was harvested, two other fields were selected in each locality. Thirty samples were collected from each field in the dry season and 50 samples in the rainly season. Previous observations have shown that mealybug populations are high during the dry season and very low, composed mostly of protected crawlers, during the rainy season (Lema & Herren, 1987).

Samples were taken to the laboratory where the mealybugs and mummies (dead, hardened and parasitized mealybugs) were counted. Living mummies (containing the immature parasitoids) from IITA and Texaco Farm were kept in gelatine capsules in the laboratory and served to determine the rates of parasitism together with the wasps which emerged from the second to fourth instars (as the first instars are not attacked (Lema & Herren, 1987) while no attempt was made to rear healthy looking mealybugs for possible parasitoid emergence.

Fourteen months after the release at IITA, i.e., 3–4 months after the release at other localities, we started to recover the parasitoids farther away from the release localities. This was done by making surveys on the Texaco Farm and along major roads throughout cassava growing areas of Nigeria. During the surveys (1) observations were made to detect the presence of the parasitoids. Only female parasitoids were considered as proof because the males are difficult to distinguish with the naked eye from those of *Prochiloneurus* sp., an indigenous hyperparasitoid; (2) cassava tips were collected and kept in the laboratory for parasitoid emergence. Two surveys were made in 1983, the first in March and the other in December. Further surveys were made early in 1984.

Results

Table 1 shows the population levels of *E. lopezi* and its host (as well as rate of parasitism) at the Institute and Texaco Farm from 1982 to 1984 From the release field *E. lopezi* has now spread into all cassava fields throughout the Institute. On the Texaco Farm, the parasitoids were found within a radius of over 300 m from the release field only 3 months after the release there and it had covered by then an area of about 28 ha.

The results of the dispersal of *E. lopezi* from the release localities to other cassava growing areas of Nigeria are presented in Fig. 1. Data from surveys made in March and December 1983 indicate that 14 months after the release at IITA and 3 months on the Texaco Farm, *E. lopezi* had colonized virtually every mealybug-infested field in Oyo and Ogun States. It was recovered in March at Ajasse, Kwara State, about 150 km away from the Institute and had spread by then into Ondo, Lagos and Bendel States (Fig. 1). In 1984, *E. lopezi* was again recovered in the above mentioned states and its presence was revealed at Nteje in Anambra State and around several localities in Imo State (Mgbowo, Awgu, Okigwe), Niger State (Jebba, Mokwa), Benue State (Itobe, Anpka, Ibado) and Plateau State (Lafia) (Fig. 1).

Discussion

Coppel & Martins (1977) consider a natural enemy as established if it is recovered after one complete year following the release, the natural enemy thus having survived the limiting season of the year in the region. DeBach & Barlett (1964), however, reported that a biological control agent

Table 1. Monthly population levels of *E. lopezi* and its host *P. manihoti* at IITA and Texaco Farm

Month 1982–84	Av. no./100 tips					
	IITA		Texaco Farm		% Parasitism	
	P. manihoti	Mummies	*P. manihoti*	Mummies	IITA	Texaco Farm
Jan.	1146.7	226.7			15.4	
Feb.	303.3	73.3			35.3	
Mar.	53.3	40.0			45.4	
Jun.	144.0	22.0			23.9	
Aug.	211.4	0.0			0.0	
Sep.	126.3	2.5			1.9	
Oct.	108.8	3.8			1.2	
Nov.	365.0	38.3	271.7	0.0	10.9	0.0
Dec.	441.7	55.0	793.3	39.2	12.5	5.9
Jan.	132.5	10.0	2106.7	196.7	7.0	8.8
Feb.	[a]	-	2961.3	232.3	-	9.5
Mar.	-	-	3306.8	263.6	-	11.1
Apr.	-	-	1743.3	206.7	-	13.7
May.	648.4	261.3	2876.7	201.7	40.7	11.2
Jun.	1.7	0.0	416.0	96.0	0.0	25.0
Sep.[b]	19.2	0.0	2.0	0.0	0.0	0.0
Oct.	148.9	3.3	35.0	0.0	6.0	0.0
Nov.	93.3	13.3	106.7	1.7	20.0	3.4
Dec.	103.8	7.7	67.5	15.3	15.1	25.0
Jan.	148.0	7.0	346.0	14.0	20.0	6.0
Feb.	394.3	32.3	353.0	35.5	19.0	22.8
Mar.	320.9	23.7	1929.0	12.0	20.7	1.7
Apr.	218.0	4.0	3069.0	22.0	2.7	2.1
May.	-	-	892.7	30.0	-	4.8

[a] = sampling not done.

[b] July & August 1983: no mummies found.

can be considered as permanently established if it can be recovered in 3 successive years after the release. A good dispersal rate, as discussed by Flanders (1947) and Doutt & DeBach (1964), is one of the attributes of an effective natural enemy. It allows the natural enemy to occupy rapidly all host-inhabited niches.

Furuhashi & Nishino (1983) in Japan reported that the wasp *Aphytis yanonensis* DeBach & Rosen spread at a rate of 30 m from the release trees in 6 months. The dispersal rate of the parasitoid *A. melinus* DeBach in Greece was about 100 km per year which was considered as very good dispersal power (DeBach, 1974).

In the present study, it can be assumed that *E. lopezi* had spread on its own from the release localities, even though the movement of planting material (infested with parasitized mealybugs) from one region to another may have also contributed to its spread. A small stock culture of *E. lopezi* was given to entomologists at the National Root Crops Research Institute at Umudike in Nigeria in October 1982 who made some releases around the Institute. It is, therefore, possible that some of the parasitoids collected around Umuahia (Imo State) may have come from these releases.

This study shows that *E. lopezi* is established in Nigeria. The parasitoid has a very good ability to disperse, having spread over a distance of about 150 km in 14 months, which looks very good to a future possibility of biological control of the cassava mealybug with this encyrtid. No data about the effectiveness, however, and the exact percentage of parasitism are available. A prediction of an effective control of the pest is as yet premature.

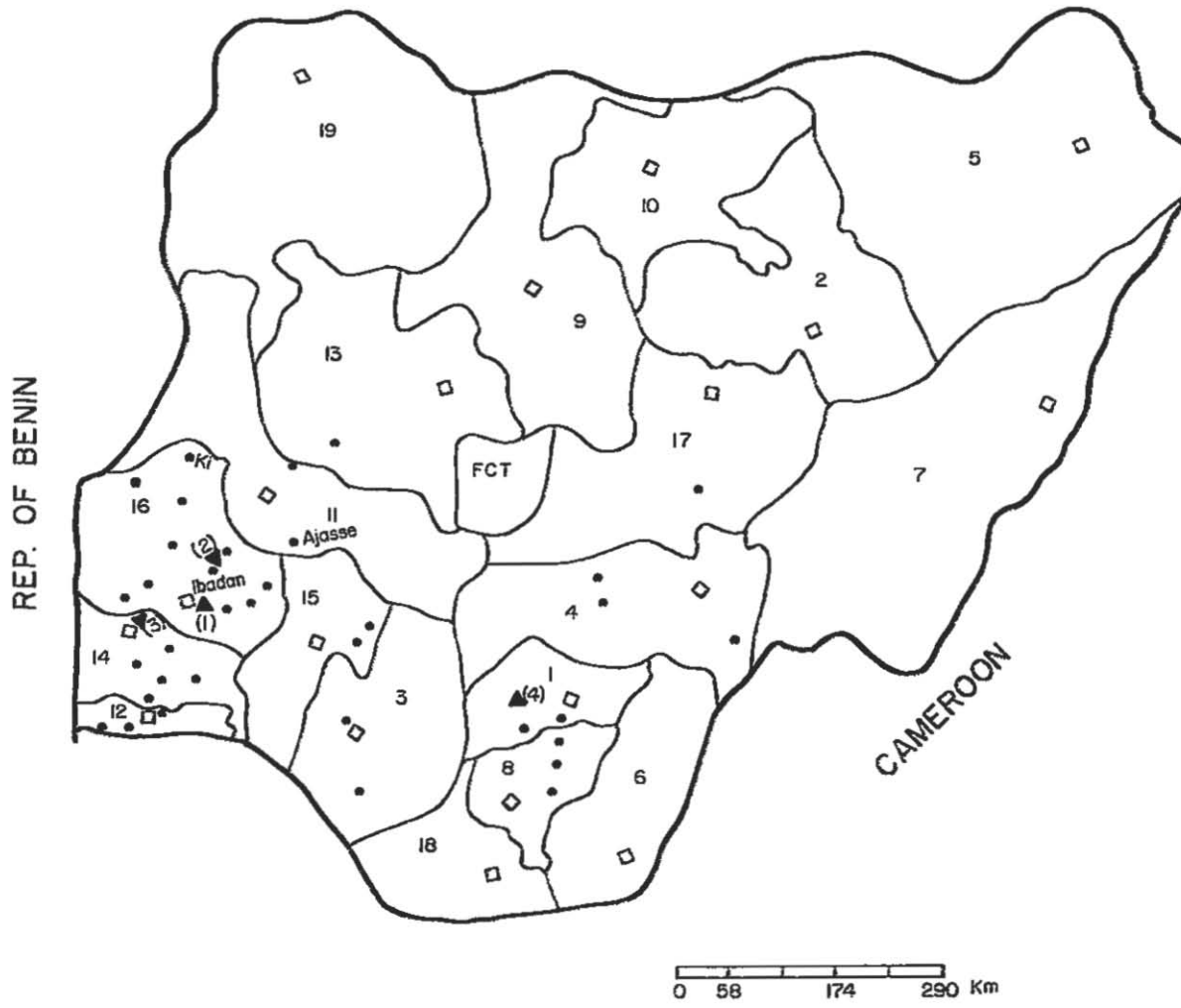

Fig. 1. Map of Nigeria with the 19 States, the release localities (▲) and dispersal of *E. lopezi* (●), years after initial release. States: 1: Anambra; 2: Bauchi; 3: Bendel; 4: Benue; 5: Borno; 6: Cross Rivers; 7: Gongola; 8: Imo; 9: Kaduna; 10: Kano; 11: Kwara; 12: Lagos; 13: Niger; 14: Ogun; 15: Ondo; 16: Oyo; 17: Plateau; 18: Rivers; 19: Sokoto FCT; Federal Capital Territory. State capitals (□).

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Résumé

*Libération et installation au Nigéria d'*Epidinocarsis lopezi, *parasitoïde de la cochenille du manioc* Phenacoccus manihoti

Epidinocarsis lopezi (*Apoanagyrus*) *lopezi* a été introduit du Paraguay au Nigéria pour lutter contre la cochenille du manioc, *Phenacoccus manihoti*. Il a été lâché dans quatre champs de manioc pour étudier son acclimatation et son installation au Nigéria. Trois ans après les lâchers, les résultats ont permis de conclure que *E. lopezi* s'est établi avec succès et se disperse dans la plupart des zones de

culture du manioc au Nigeria; il a aussi survécu à trois saisons pluvieuses pendant lesquelles les populations de *P. manihoti* ont été très faibles. Quatorze mois après les premiers lâchers, cet encyrtide a été obtenu à environ 150 km du lieu de libération.

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