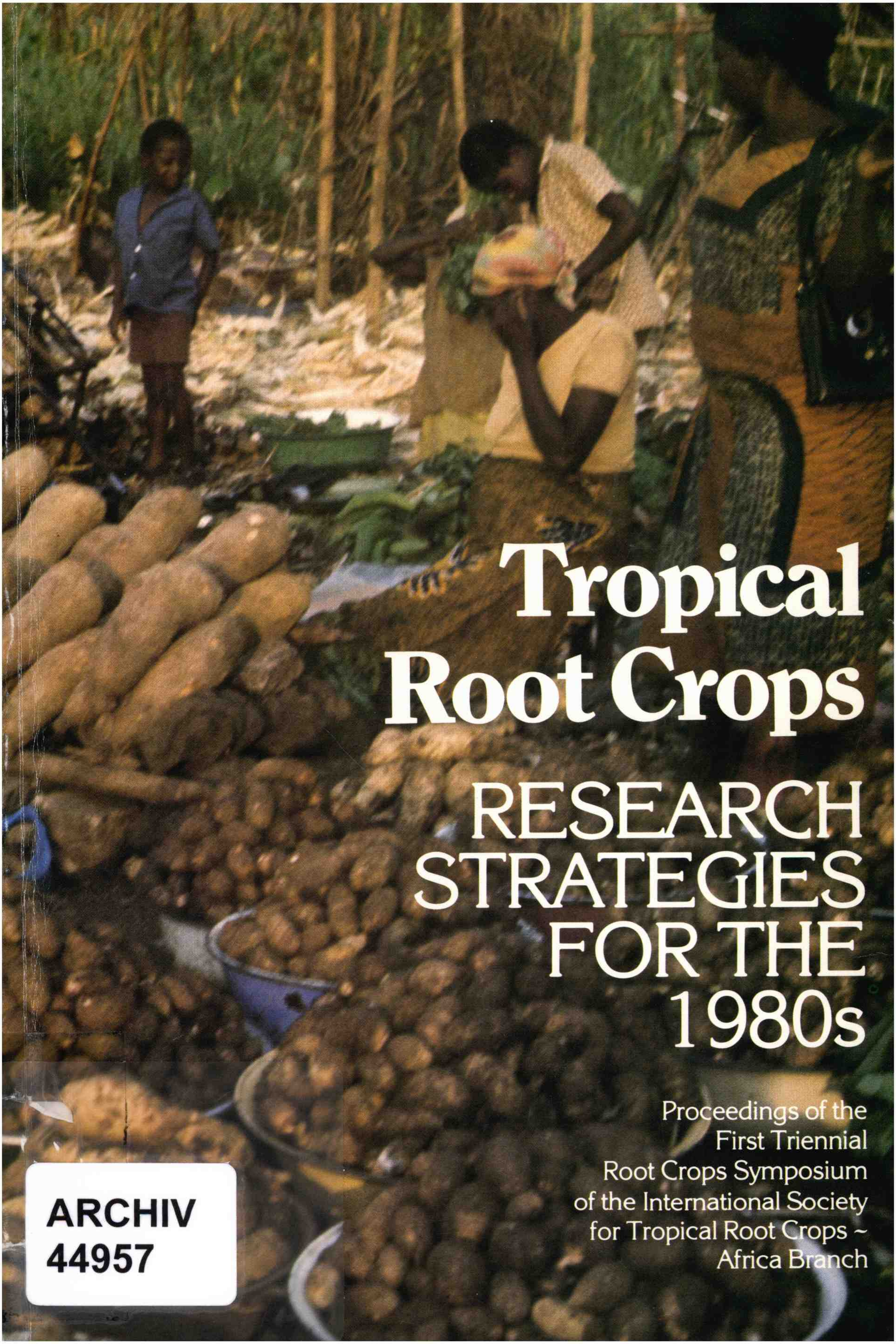

Tropical Root Crops

RESEARCH STRATEGIES FOR THE 1980s

Proceedings of the First Triennial Root Crops Symposium of the International Society for Tropical Root Crops ~ Africa Branch

IDRC-163e

TROPICAL ROOT CROPS: RESEARCH STRATEGIES FOR THE 1980S

PROCEEDINGS OF THE FIRST TRIENNIAL ROOT CROPS SYMPOSIUM OF THE INTERNATIONAL SOCIETY FOR TROPICAL ROOT CROPS — AFRICA BRANCH, 8–12 SEPTEMBER 1980, IBADAN, NIGERIA

EDITORS: E.R. TERRY, K.A. ODURO, AND F. CAVENESS

The International Development Research Centre is a public corporation created by the Parliament of Canada in 1970 to support research designed to adapt science and technology to the needs of developing countries. The Centre's activity is concentrated in five sectors: agriculture, food and nutrition sciences; health sciences; information sciences; social sciences; and communications. IDRC is financed solely by the Parliament of Canada; its policies, however, are set by an international Board of Governors. The Centre's headquarters are in Ottawa, Canada. Regional offices are located in Africa, Asia, Latin America, and the Middle East.

The International Society for Tropical Root Crops — Africa Branch was created in 1978 to stimulate research, production, and utilization of root and tuber crops in Africa and the adjacent islands. The activities include encouragement of training and extension, organization of workshops and symposia, exchange of genetic materials, and facilitation of contacts between personnel working with root and tuber crops. The Society's headquarters is at the International Institute of Tropical Agriculture in Ibadan, Nigeria, but its executive council comprises eminent root and tuber researchers from national programs throughout the continent.

Postal Address: Box 8500, Ottawa, Canada K1G 3H9
Head Office: 60 Queen Street, Ottawa

Terry, E.R.
Oduro, K.A.
Caveness, F.

International Society for Tropical Root Crops. Africa Branch, Ibadan NG

IDRC-163e

Tropical root crops: research strategies for the 1980s. Ottawa, Ont., IDRC, 1981. 279 p. : ill.

/IDRC publication/, /root crops/, /agricultural research/ — /plant breeding/, /plant diseases/, /cassava/, /sweet potatoes/ , /pests of plants/ , /plant production/ , /weed control/ , /intercropping/ , /harvesting/ , /crop yield/ , /conference report/ , /list of participants/ , /agricultural statistics/.

UDC: 633.4 (213)

ISBN: 0 88936 285 8

Microfiche edition available

Cooperating institutions

CANADA

CONTENTS

DYNAMICS OF CASSAVA MEALYBUG POPULATIONS IN THE PEOPLE'S REPUBLIC OF CONGO

G. FABRES

OFFICE DE LA RECHERCHE SCIENTIFIQUE ET TECHNIQUE OUTRE-MER, BRAZZAVILLE, PEOPLE'S REPUBLIC OF CONGO

I undertook a study of the succession of generations of *Phenacoccus manihoti* and the variations in population sizes. I used the method of Benassy (1961) adapted by Fabres (1979) and counts of the populations on leaves and shoot apexes and found extreme variation on apexes, ranging from 1–3 mealybugs in the rainy season to more than 70 during pullulation. The role of rain in halting the growth in population is clear. There were three successive generations in the dry season, enabling the pest's population to multiply by a factor of almost 20. Altogether there were nine generations.

Recherche sur la succession de générations de *Phenacoccus manihoti* et les variations de densité de population. Le compte des cochenilles sous les feuilles et les apexes, selon la méthode Benassy (1961) adaptée par Fabres (1979) a révélé des variations extrêmes allant de 1 à 3 au cours de la saison des pluies à plus de 70 cochenilles en période de pullulation. Le rôle de la pluie sur la croissance de la population est globalement mis en évidence. En saison sèche, trois générations se sont succédées et la population des ravageurs a multiplié ses effectifs par un facteur voisin de 20, ce qui a donné neuf générations pour l'ensemble.

Phenacoccus manihoti was recently introduced into Central Africa from the New World. This crop-destroying mealybug has caused spectacular havoc in cassava plantations and has therefore aroused a great deal of interest. At a colloquium in Zaire in 1978, many contributors mentioned the problem of cassava mealybug infestation and described methods for controlling its populations.

However, the number of studies dealing with the bioecology of *P. manihoti* is relatively small: Ezumah and Knight (1978) and Leuschner (1978) mentioned the proliferation of the mealybug in the dry season but did not quantify it or use a cassava stem infestation index (% infected), whereas Nwanze et al. (1980) dealt with the bug's bioecological parameters without looking at its population dynamics.

Thus this study, the results of which are described below, is the first to provide quantified information on the variations in cassava mealybug populations and on the intrinsic or climatic factors that govern them.

METHODS

This study was conducted in fields of cassava of the "m'pembe" strain, near Brazzaville (Kombé Farm). The data gathered and analyzed cover the year 1979. The subject of the study was the succession of generations of *P. manihoti* and the variations in population sizes.

The method used for the succession of generations was developed by Benassy (1961) and applied to tropical countries by Fabres (1979). It consists in taking a weekly vegetation sample and making a count of all bugs found, tabulated according to their stage of development. Depending on the season, counts varied from 200 to 1000 mealybugs. The counts make it possible to find out the proportion of each stage within the colony and to determine precisely the succession of generations during the climatic year. A detailed analysis of the results of this study was made (Fabres 1980), and here I will summarize only the essential data.

I used the method of sight counts in the field to determine variations in population size. Each week 100 shoot apexes were picked at random in the sampling fields; the presence or absence of the bug was determined, and the rate of infestation of the apexes and leaves. On 30 apexes, all bugs were counted and the different stages noted. Each week, therefore, I obtained a percentage of apexes infested, an average rate of infestation, and a mean value of the number of mealybugs per apex. A parallel study was conducted on random samples of leaves, six leaves to an apex, or 180 leaves per week.

Annual variations in the percentage of apexes infested and the rate of infestation are given in Table 1. The relationships between average num-

Table 1. Variations in percentages of shoot apexes infested and average rates of infestation.

Date (1979)	Infested apexes (%)	Infestation rate (%)
13/6	24	6
29/6	51	12
16/7	56	15
30/7	66	20
14/8	46	27
29/8	83	40
13/9	70	49
29/9	96	45
14/10	100	83
13/10	100	100
14/11	100	100

bers of mealybugs per apex and absolute maxima are given in Table 2. Variations in densities over time are shown in Fig. 1, together with a daily rainfall curve and a diagram of the successive generations. Note that the numbering of generations is artificial, generation 1 being the one with which the count began.

RESULTS

The variation in the number of *P. manihoti* per apex is extreme, ranging from 1–3 mealybugs per apex in the rainy season to more than 70 in a period of pullulation. Absolute maxima may reach 600 or 700 bugs per apex, as on 20 September 1979 (Table 2). On leaf organs, densities are lower, not exceeding 300 or 400 mealybugs per leaf (Table 2).

The changes in the percentage of apexes infested in relation to the total number of plants examined show that the propagation of the infestation is very rapid. Although in June only 20% of apexes were infested, in July the number had reached 65% (Table 1). By the end of September, mealybugs were found on all apexes. The rate of infestation is more gradual, and it was not until October that maximum (100%) infestation had occurred, from 45% in September.

The curve in Fig. 1 shows the precise evolution of the average population per apex. In February, when the count began, densities were very low. They fluctuated between 0 and 10 until June. From July on, there occurred a rapid increase in the population that brought the density to some 70 bugs per apex at the end of October. This increase was not constant but occurred in three successive stages in June–July, August–September, and September–October. From November on, almost all the mealybugs had disappeared with the advent of the torrential rains marking the beginning of the season. Densities were very low in comparison with February numbers.

The role of rain in halting population growth is clear. The increase in density between June and October coincided with the dry season and the complete cessation of rainfall. The bug's near disappearance and continuing low population levels corresponded to the onset of the rains and their continuing abundance. The short dry period in March was marked by a slight increase in *P. manihoti* densities.

In this seasonal context of the variations in population sizes, a study of the succession of generations provides additional information making it possible to interpret the curve in Fig. 1: generations 1, 2, and 3 ensured the transition between rainy and dry seasons and showed low densities. Generations 1 and 2 developed during the season of light rains, generations 7, 8, and 9 during the season of heavy, torrential rains, during which the mealybug became very scarce. Generations 4, 5, and 6 were those responsible for the proliferation of the mealybug in the dry season, and the three stages noted on the curve of variations corresponded to the development of these three successive generations.

Table 2. Mealybug densities in rainy and dry seasons — average numbers and absolute maxima from counts on shoot apexes and leaves.

Date (1979)	Average mealybugs/ apex	Maximum	Average mealybugs/ leaf	Maximum
2/8	30.4	62	7.5	50
9/8	37.2	84	3.6	38
16/8	25.5	120	4.5	41
23/8	35.0	77	2.0	75
30/8	35.7	50	3.6	74
20/9	67.1	679	18.5	125
27/10	70.0	252	43.3	336

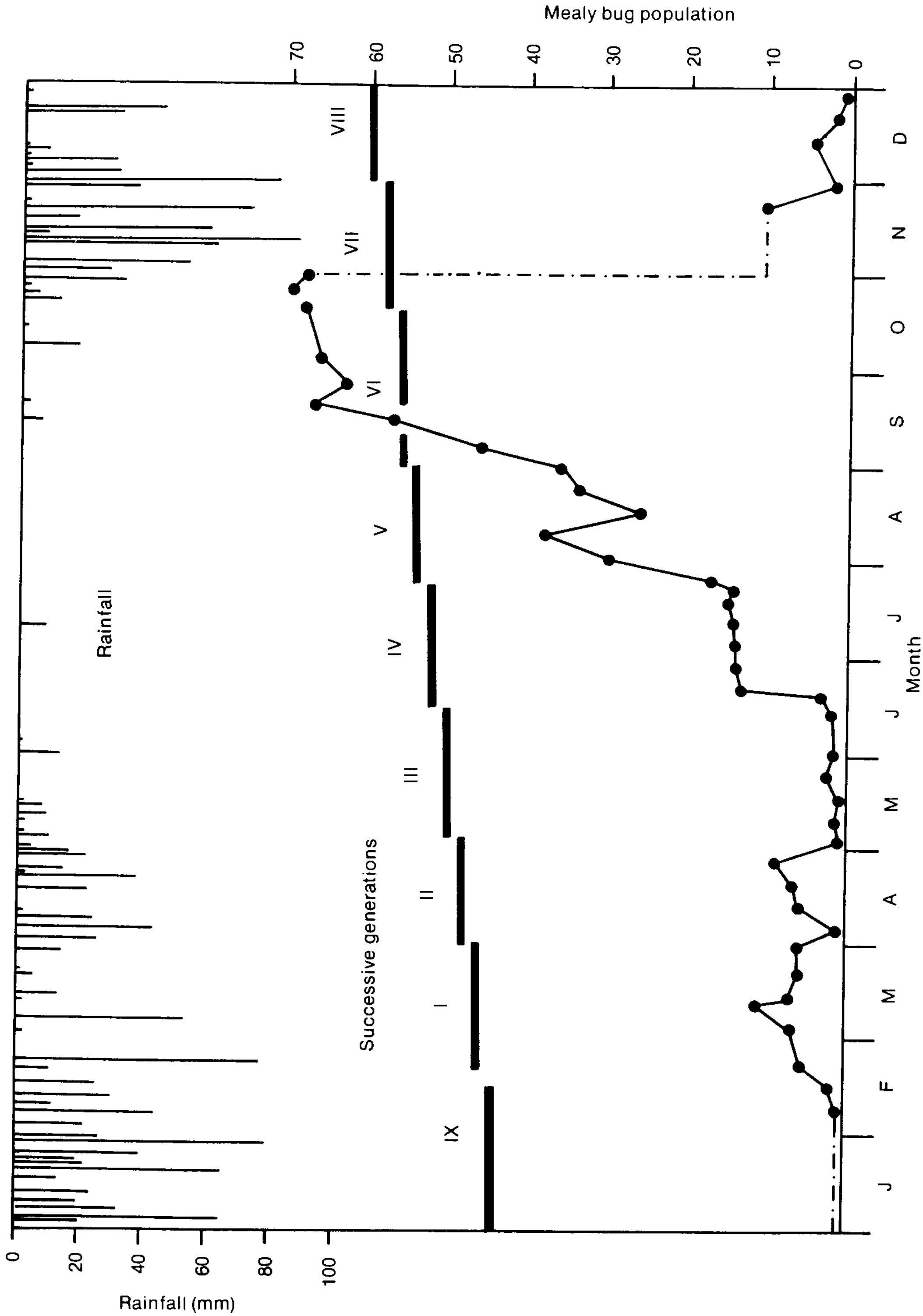

Fig. 1. *Mealybug population.*

CONCLUSIONS

This study is the first to quantify precisely the variations in *P. manihoti* population sizes during a climatic year. Following the work of Ezumah and Knight (1978) and Nwanze (1978), I have demonstrated the mechanical role of rainfall and calculated its impact on population density. This mechanism explains the swift disappearance of the colonies at the onset of the rainy season.

The role played by the three successive generations in the dry season is fundamental, enabling this pest's population to multiply by a factor of almost 20. This phenomenon is due to the Pseudococcidae's enormous multiplication potential. It was in fact determined, during a previous study (Fabres 1980), that the intrinsic rate of multiplication (rm) is 0.15 at 26°C and 75% relative humidity and that the generation time is between 28 and 33 days in the dry season.

The results of this study are directly related to the current concern with the control of this pest. Awareness of the mechanisms of variation in *P. manihoti* population sizes and the factors to which they are due should lead to the development of agronomic control methods. The use of early varieties of cassava, which develop their roots before proliferation occurs, has already been considered. It should also be possible to reduce the densities of generations 5 and 6 to prevent pullulation.

In line with the biological control programs being developed in Central and West Africa, the information I have gathered on a parasite-free population represents the indispensable basic data that, following the introduction of exotic New World parasites, will make it possible to compare the fluctuations in the pest's densities and measure the parasites' regulating capacity.

This paper was originally French; with the author's permission, it was translated into English for inclusion in these proceedings.