THE ROLE OF Neozygites fumosa IN REGULATION OF CASSAVA MEALYBUG POPULATIONS

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INTRODUCTION

The cassava mealybug, Phenacoccus manihoti Matile-Ferrero (Homoptera: Pseudococcidae), originating from the tropical regions of South America, has in all likelihood been introduced accidentally into Africa in the early 1970s. It is considered to be one of the major pests of cassava, causing a crop loss of around 30 % (K.F. Nwanze, Tropical Pest Management, 28, 27-32, 1982).

In the Brazzaville region, an area of very eroded savannah, the populations of P. manihoti reach their maximal level at the end of the dry season. The number of mealybugs decreases drastically at the beginning of the rainy season and then remains at a very low level until the following dry season (G. Fabres, Agr. Trop., 369-377, 1982; B. Le Rü, Thèse 3ème cycle, Univ. Paris XI, 122 p., 1984).

The important regulating action of an entomophthoraceous fungus, Neozygites fumosa (Speare) Remaudière and Keller was observed in the Congo in 1982 and 1985. In 1982 the modalities of the disease have been specified (B. Le Rü, Entomophaga, 31, in press). In the current work, the observations of 1985, established from a different method of sampling, allow us to refine its outline.

1982 RESULTS

In 1982, the level of fungal infection due to N. fumosa was estimated by counting all diseased and living mealybugs on 30 cassava stalks chosen randomly in the field. The presence of the pathogen on the African continent was mentioned for the first time, as well as its pathogenic action against P. manihoti. The efficiency of the disease is shown by the concomitance of the halt in the growth of the populations and the rapid increase in the level of mycosis during the month of October (less than 1 % and more than 40 % respectively at the beginning and the end of the month). The extension of the disease to N. fumosa seems to be conditioned by a relative humidity level of above 90 % over several consecutive days, and by minimal temperature greater than 20°C. The spread of the disease within the P. manihoti population also seems dependent on the host density; the level of mycosis is always higher on the most infested plants. Furthermore, the females appear to always be more infested by the fungus than the larval stages. Moreover, at the beginning of the population decline, the number of infected mealybugs appears to be relatively small compared to their total number, thus the existence of a factor other than mycosis has been implicated in the decrease of the number of insects (Le Rü, 1986, loc. cit.)

1985 RESULTS

In 1985 the counts were carried out in the same fashion weekly as in 1982, but biweekly on the same cassava stalks during the whole study period. Again in 1985 we observed the same extension of the mycosis in relation to humidity and temperature (Figure 1) as well as to population density (Table 1).

TABLE 1: Analysis of the correlation between the number of mealybugs killed by mycosis and the number of live mealybugs in the P. manihoti colonies contaminated by N. fumosa in 1985.

Day	n	r_s	P_1(%)	P_2(%)
15/10	19	0,717 (a)	63	24,0
22/10	18	0,792 (a)	60	27,7
02/11	23	0,987 (a)	77	50,1
09/11	15	0,816 (a)	50	52,1

n = number of colonies observed; r_s = Spearman's coefficient of rank correlation; (a): correlation significantly different from 0 at the 5 % level; P_1 = percentage of plants sustaining infected mealybugs; P_2 = percentage of mycosis in the population.

The evolution of the mycosis due to N. fumosa is dependent on the population level of the host; this phenomenon is probably related to the biological characteristics of the host (gregarious tendency, feeble mobility) and that of the pathogen (discharge of the conidia to a short distance and the rapid evolution of the primary conidium to an adhesive capilloconidium) as has been pointed out by C.A. Dedryver (Entomophaga, 23, 137-151, 1978) in the case of another species of Neozygites, the aphid pathogen N. fresenii (Nowakowski) Remaudière and Keller.

The role of the developmental stage is also confirmed. The females are under a much greater attack by the pathogen than the larvae during almost the entire period of study (Table 2). The R_h ratio appears to be always superior to the correspondant value of R_m.

TABLE 2: Variations of the ratios R_h (Number of healthy larvae/number of healthy females), R_m (Number of diseased larvae/number of diseased females) and R_t (Total number of larvae/total number of females).

	29/08	28/09	07/10	15/10	22/10	2/11
Rh	11,8	13,1	6,0	1,8	4,5	6,2
Rm	2,0	1,3	1,8	1,5	0,7	7,8
RT	11,5	12,9	4,8	1,6	2,4	7,3

In both 1982 and 1985 the spread of the disease was observed during a period of ageing of the population (R_T diminishes) which is reflected by an increase in the period of exposure of the individuals to the pathogen. The very favourable climatic conditions then allow the pathogen to considerably amplify the quantity of inoculum. When the massive hatching of the young larvae occurs at the end of October the quantity of inoculum is such that the period

Figure 1: Variations of the population density of Phenacoccus manihoti on cassava at Kombe, near Brazzaville, from august to december 1985, in relation to climatic characteristics (•—•—•—•: total number; ✱—✱—✱—✱ and o—o—o—o: number of healthy and diseased mealybugs respectively; ··········: percentage of mycosis).

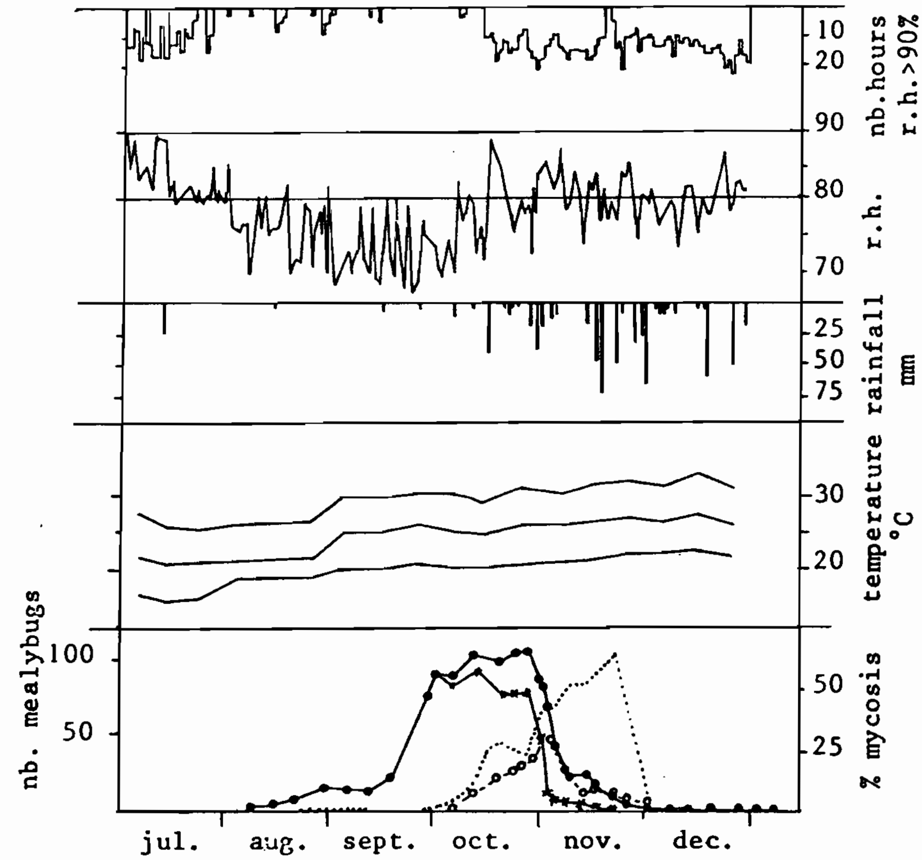
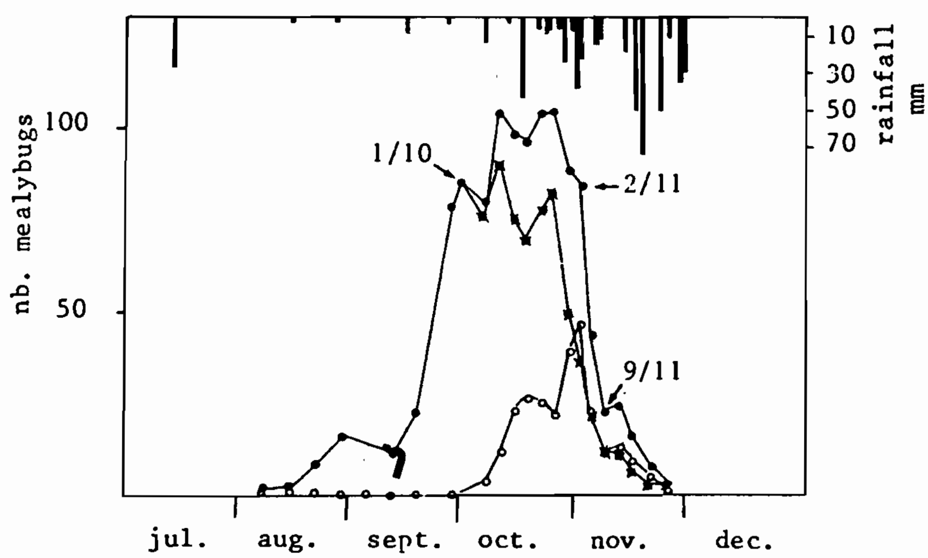


Figure 2: Influence of the rainfall on the population density of P. manihoti on cassava at Kombe (detail from figure 1).



of exposure to the pathogen is no longer a limiting factor. The two ratios R_m and R_s are similar.

Furthermore, we took an interest in the eventual mechanical action of rhe rains on the evolution of the population structure. In fact, in the tropical zone, the violence of the rain, often of a stormy nature, was considered a basic factor in the elimination of a portion of the population of mealybugs. So, in 1985, counts were conducted every three or four days on the same 30 apexes which allowed us to follow precisely the population structure.

So we distinguished two periods (Figure 2). A first period (from 1/10 to 2/11) during which the total numbers remain stationary (86 and 85 mealybugs/stalk respectively the 1/10 and the 2/11), in spite of a large hatching of young larvae at the end of October. An important fraction of the population is thought to be eliminated by the rains (10 rains during this period). The part of the mechanical action of the rains on the healthy fractions and those with fungal infection cannot, however, be evaluated. The disease in the number of healthy elements (- 48 mealybugs/stalk) is found to be accompanied by the increase in the diseased insects (+ 47 mealybugs/stalk). A second period from 2 to 9 November, during which there were only three rainfalls, was characterised by a brutal drop in the total numbers (- 62 mealybugs/stalk). The respective numbers of healthy and infected insects decreased rapidly, respectively -25 and - 37 mealybugs/stalk. Whilst on 2 November the number of diseased individuals was 23 % higher than that of the healthy ones, seven days later they were identical. The drop in number of diseased individuals seems much more rapid than that of the healthy ones, in spite of the spread of the disease. It is probable therefore that the infected portion of the population is more sensitive to the mechanical action of the rains. In 1982 we had underlined the eventuality of the elimination of a fraction of the total population by a factor other than mycosis. The observations of 1985 allow us to suppose that the rapid decrease in the mealybug populations is mainly due to the mechanical action of the rains on the diseased portion of the insect colonies.

DISCUSSION AND CONCLUSION

The important role played by a microorganism in the natural regulation of the P. manihoti populations has been shown in the course of two years of observation. One can note the great similarity between the observations of 1982 and those of 1985, despite the use of two different sampling methods. The method employed in 1985 allows one to give more information on the evolution of the populations' structure and on the respective roles of the different mortality factors. It makes possible frequent countings without the risk of disturbing the biotope. On the contrary the method used in 1982, more exact in the period of proliferation necessitates the removal of sample apexes (10 at least) which, given the often reduced size of the study plots, is bound to seriously disturb the mealybug populations. This latter method must, however, be advocated during research of an extensive nature in zones which are difficult to access, for it allows one to reduce the frequency of the countings which can be effected extemporaneously on the apexes gathered and then taken to the laboratory.

The mechanical role of the rains which particularly eliminates the diseased fraction of the population is demonstrated here for the first time. This last point seemingly can be explained quite easily by the absence of rhizoids on N. fumosa and by the often forceful character of tropical rainfall. This explains why the number of individuals dead from mycosis remains low while the spread of fungus can be considered as epizootic.

Le Rü Bruno (1986)

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