TEMPORAL DEVELOPMENT OF AFRICAN CASSAVA MOSAIC

FARGETTE, D., FAUQUET, C. & THOUVENEL, J-C.
Laboratory of Virology, ORSTOM, BP V 51
ABIDJAN, IVORY COAST

INTRODUCTION

The development over time of a viral disease depends on many factors. Among those investigated in the case of the African Cassava Mosaic are the place and the date of planting, the clone used, and the situation in the field.

Factors that affect the development of the disease

Completely different epidemics may develop on different sites, even if they are very close to each other. For example, the degree of contamination of initially healthy fields was much lower in Toumodi (200 km north of Abidjan) (2%) than in Tontonou (36%), which is only a few kilometres away from Toumodi, and lower than in Adiopodoumé (20 km west of Abidjan) (62%) (see the accompanying paper "Epidemiology of cassava mosaic on a regional scale in the Ivory Coast").

In a given field, the incidence of the disease depends on its position in the field. The recontamination was much lower at the center of the field and near the downwind edges (18 and 34%, respectively) than at the upwind edges (89%) (see the accompanying paper "Distribution and spread of African Cassava Mosaic in a cassava field").

The clones showed a high variability of resistance in the field. For example, a very low incidence of the disease was observed in a hybrid of M. esculenta and M. glaziovii (18%), whereas strong contaminations were observed among the local clones (89%) (see the accompanying paper "Resistance of cassava to African Cassava Mosaic").

In a given site, for a similar exposure and a given clone, the incidence of the disease depended broadly on the planting date: it was low in October (12%), high in April (44%), and very high in December (89%). Our investigation of this fluctuation throughout the year is the focus of this communication.

Annual fluctuation of the inoculum pressure

From 1981 to 1986, an area of 0.1 ha was planted with cassava each month. Every week samples were taken, the incidence of the disease was determined, and the infected cassava plants were rogued. An index of inoculum pressure was calculated from the increase in incidence of the disease in the cassava plots from the second to the third month. The whitefly populations were evaluated by weekly samplings. Leaf growth was monitored by the Laboratory of Agronomy (work of M. Rafaillac), and the leaf area index (LAI) was calculated 60 to 90 days after the planting. Detailed climatic data are available for the whole of this period. The curves of progression of the spread of ACMV differ from month to month and the "classic" adjustments may not be applied to the whole set of contamination curves. A high contamination despite the roguing of diseased plants indicates that there was an influx of virus-bearing whiteflies all year long in the fields. This situation differs from that in Toumodi, where the level of contamination registered was low.

According to the results obtained over 5 years, it appears that an annual fluctuation occurred in each of the following vaiables:

Inoculum pressure: High from March to July, low from August to November. Obviously, this fluctuation of the inoculum pressure can be observed only if virus-free planting material is available and if it is planted on different dates. Such conditions are generally not fulfilled in Africa, where the vast majority of plant material is virus-infected. So, it is not surprising that this fluctuation in inoculum pressure was not often mentioned in the national questionnaires.

Whitefly population: High from February to June, low from July to October. This fluctuation in the populations of aleurodes throughout the year, linked with climatic data, was often noted in the national questionnaires. The relationship between the peaks in the whitefly population and the rainy season and, conversely, the absence of whiteflies in the dry season has been reported several times.

Cassava leaf growth: High from February to May, low from June to September. It is recognized that certain periods favour the growth of cassava.

Temperature: Although the variation was not great, the highest temperatures were observed from February to May and the lowest from June to October.

Virus/vector/plant/environment relationships

We have investiged the relationships between the virus, the vector, the plant, and the climatic conditions of the environment. With appropriate shifts in time, there are close relationships between rate of contamination, size of the aleurode populations, and climatic data. On the basis of the relationships mentioned above (bearing in mind that it is just one possible explanation), a simple series of events can be envisaged that takes account of the relationships bewteen the environment, the vector, and the contamination. The climatic conditions, in particular the temperature, determine the size of the populations of whiteflies, which acquire and then transmit the virus. This would determine the contamination rate in the cassava fields. This outline, in view of the complexity of the relations between the different actors in the epidemic, must be only a simplification of reality. However, it must be stressed that the data obtained in greenhouses relating to the duration of development from egg to adult (approximately 3 weeks at 26 C) and the latent period of the pathogen agent in the plant (approximately 4 to 6 weeks) are compatible with the proposed diagram.

Prediction of the development of the disease

In order to test the value of the relationships shown, we have sought to use them predictively. The descriptive value of our model is high. The predictive value of the model is also high.

The predictive value of a model is evaluated by comparing calculated values or "predictions" with observed values which were not used in the construction of the model. Two types of prediction are possible. From the mean climatic conditions of Adiopodoumé, one may establish a curve of "typical" contamination and define the probable periods of high and low inoculum pressures. Given the variability of the climatic conditions from year to year, this prediction only approximates the real situation. Conversely, it is possible to predict the rate of contamination 2 months in advance, with a high degree of certainty. Such a predictive model has limits. Though this model accounts for and appropriately predicts the speed of contamination at Adiopodoumé with good precision, it may apply only in the conditions tested and therefore may not automatically be extended to other places than Adiopodoumé.

CONCLUSIONS

There is therefore an annual and seasonal fluctuation of the inoculum pressure. On the other hand, there are highly resistant varieties in the field. We are at present testing some of them, but it now appears that it is possible to maintain, at Adiopodoumé, and therefore in regions of strong inoculum pressure, several successive years of observation of the fields where the contamination is of the order of several per cent. It is tempting to try to recommend planting dates based on the knowledge of this fluctuation, using specially chosen varieties. It seems that such recommendations would make sense only subject to two conditions: first that the dates recommended be compatible with the agronomic requirements for cultivation; and secondly, that this planting guarantees the farmer that the cassava plants derived from healthy cuttings will give enough healthy plants each year to provide a sufficient stock for replanting the following year (it is probably not possible to provide healthy material to the farmer every year, for obvious reasons of cost). Fluctuations from year to year make such guarantee impossible. This uncertainty is the main weakness of such control methods. No one can guarantee the farmer that the recommended variety, combined with the recommended agricultural methods, will enable him to overcome the disease with any degree of permanence. This problem is particularly complex, and crucial, and it constitutes one of the main concerns of this colloquium: how viable are such control methods, in biological, economical, and human terms?

Fargette Denis, Fauquet Claude, Thouvenel Jean-Claude. (1987)

Temporal development of african cassava mosaic

In : African cassava mosaic disease and its control. Wageningen : CTA, 121-124. International Seminar on African Cassava Mosaic Disease and its Control

Yamoussoukro (CIV), 1987/05/04-08