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CASSAVA MEALYBUG (PHENACOCCUS MANIHOTI) AND GREEN MITES (MONONYCHELLUS spp.) BIOLOGICAL CONTROL : AN EXAMPLE OF CLASSICAL BIOLOGICAL CONTROL FOR AFRICA

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SUMMARY

The cassava Mealybug (CM) and the Green Mite (CGM) complex have been first discovered in Africa in the early seventies. Having been accidentally introduced from South America into Africa, they spread rapidly over most of the cassava belt, leaving behind heavy losses, up to 80 per cent of root yield. They are now threatening the staple of 200 million people who depend for over 50 per cent of their caloric intake from this starchy crop. IITA has taken the lead in the biological control approach to solve the problems posed by these two pests and is training local entomologists in this aspect of pests control practices. Exploration in the area of the pests (South America) has yielded so far, 27 CM natural enemies species and 25 CGM predatory (phytoseiid mites). Seven CM and 3 CGM natural enemies have so far been introduced to Nigeria for detailed bionomic studies and experimental releases in the different ecological zones of the African cassava belt. One CM parasitoid, *Epidinocarsis lopezi* has been established in eleven countries and is spreading rapidly. Its impact is dramatic and chances of success very high. New species of CM and CGM natural enemies are being introduced for the establishment of an equilibrium situation in the African cassava agro-ecosystem.

RESUME

La cochenille du manioc et le complexe d'acariens verts ont été découverts tout d'abord en Afrique dans les débuts 1970. Ayant été introduits accidentellement d'Amérique du Sud en Afrique, ils se sont rapidement propagés dans la plupart des zones à manioc entraînant de lourdes pertes atteignant jusqu'à 80 pour cent des rendements en tubercules. Ils menacent maintenant l'alimentation de base de 200 million de personnes dont l'apport calorique dépend pour plus de 50 pour cent

de cette culture vivrière. L'IITA a pris la tête de programmes de lutte biologique pour résoudre les problèmes de ces deux ravageurs et forme des entomologistes locaux aux pratiques de lutte contre ceux-ci. Les prospections dans les pays d'origine de ces ravageurs (Amérique du Sud) ont permis d'obtenir 27 espèces d'ennemis naturels pour la cochenille et 16 prédateurs pour les acariens (Phytoseiid). 6 ennemis naturels de la cochenille et 3 prédateurs des acariens ont été introduits au Nigeria pour des études biologiques précises et des lachers expérimentaux dans les différentes zones écologiques africaines de culture du manioc. Un parasite de la cochenille Epidinocarsis lopezi a été établi dans six régions et s'est rapidement répandu. Son action paraît importante et les chances de succès semblent très élevées. De nouvelles espèces d'ennemis naturels de la cochenille et des acariens prédateurs sont en cours d'introduction afin d'arriver à établir un équilibre biologique stable dans l'agro-écosystème du manioc en Afrique.

INTRODUCTION

After their accidental introduction into Africa in the late sixties and early seventies, the Cassava Mealybug (CM) and Green Mites (CGM) have spread rapidly across the cassava belt, covering more than 75 per cent of its total area.

The severe root yield losses as well as the loss of leaves and planting material have prompted the development of a continent-wide strategy to bring the two pest under control.

IITA has therefore taken the lead in the development and implementation of the Africa-wide Biological Control Project (ABCP). This Project is carried out in collaboration with other international organizations, namely, the Centro International de Agricultura Tropical (CIAT) in Cali, Colombia; the Commonwealth Institute of Biological Control (CIBC) in Trinidad and London ; the Empresa Brasileira de Pesquisa Agropecuaria (EMBRAPA), Brazil, for the exploration and quarantine work ; the Commonwealth Institute of Entomology (CIE) and the British Museum of Natural history in London for taxonomy work ; the University of California, Berkeley, and the Federal Institute of Technology in Zurich for plant-pest interaction research, as well as many scientists from different continents and as many as 23 Institutions.

The ABCP is financed by a group of donors, among them the International Fund for Agricultural Development (IFAD) and the Aid Agencies of Switzerland, Austria, West Germany, the Netherlands, Denmark and Italy. The International Development Research Center (IDRC) is financing directly CIBC activities related to CGM biological control in East Africa (except quarantine).

The biological control approach has been chosen in view of the exotic status of the two pests. The feasibility study conducted by IITA between 1980 and 1984 has shown the

great potential of this approach. The ABCP emerged from this study and is now being implemented. The objectives of the ABCP are :

(1) to achieve a permanent, ecologically safe and economically sustainable control of both the Cassava Mealbug (CM) and the Cassava Green Mites (CGM) in Africa by establishing a scientific base to carry out a classical biological control programme.

(2) Train biological control technicians nationally as support specialists to asist our immediate efforts to control the two pests (short-term extension type training courses at IITA & CIBC), support financially and technically graduate and post-graduate students in biological and integrated pest control disciplines and initiate national biological control programmes.

(3) Create by the combination of the above two points, an African biological control capability to carry out other biological control projects on a national or regional basis using the ABCP as a training model.

RESULTS

The short term allocated for this paper doesn't allow for more than a few highlights of the work so far accomplished by the IITA team and its collabarators in South america, U.S., EUROPE and Africa.

(a) Exploration

In view of the needs to have a wide complex of natural enemy species to establish a stable and efficient control of the two pests, continued efforts have been and are still being made to locate the whole natural enemy complex of these pests in South and Central America.

Of the numerous species so far identified and collected by the CIBC, IITA and CIAT teams, two parasitoids and five predators of the CM and three predators of the CGM have been successfully introduced into Nigeria for detailed bionomic studies and experimental releases. CM parasitoids : *Epidinocarsis lopezi, Allotropa* sp., predators : *Hyperaspis ? jucunda, H. notata, Hyperaspis* sp., *Diomus, Sympherobius maculipennis* ; CGM predators : *Neoseiulus idaeus, N. anonymus, Phytoseiulus persimilis*).
Linked with the exploration activities are the very important quarantine laboratories and the CIE in London.

(b) field Ecology And Bionomic Research

Major efforts are being undertaken in the ABCP to have a comprehensive scientific basis for its implementation and its impact assessment. To this end, the host plant-pest insect and mites interactions have been assessed in field experiments over the last three years. The collected data are now analysed and used in the validation process of a computer simulation model, which includes the host plant, the CM and CGM and, in the future, the natural enemies. Efficient sampling procedures for the CM, CGM and their natural enemies have already been developed and are being used by the field staff across Africa in pre and post-release monitoring. Economic injury levels have been established and are used for the impact assessment.

(c) Biological Control Technology development (Mass-Rearing/Release)

In order to carry out the ABCP according to time schedule as required by the magnitude of the problem, the large scale mass production of beneficial insects and mites is being concentrated in one location during the ABCP's first phase. After three years of efforts in developping mass-rearing systems for CM, CGM and their natural enemies, a system of rearing modules or "Cassava Trees" is now in its final test phase. The system has different technology levels to take into account the diffential abilities of National Programmes to handle them. It uses an aeroponic plant growth system and every module is fully independent. The full eight week cycle from planting to natural enemy collection is done under total isolation and in one operation. When operational, this system will be decentralized and used in regional biological control laboratories.

The ground release of CM and CGM natural enemies over large areas remains a major obstacle to an efficient control operation. To overcome it, IITA has developed, along with the mass-rearing technology, aerial release and automatic packaging systems. The aerial release system has been extensively tested at IITA and the first operational experiments have been carried out it Ghana in February-March 1985. Recoveries of field reproducing *E. lopezi* in the aerial release areas show the potentiality of this method for large scale releases. Although CGM/predators have also been released, the CGM population has so far been too low to allow the recovery of eventually established phytoseiids.

(d) Experimental Releases and Monitoring

So far, releases of CM natural enemies reared in IITA have been made in 10 countries. These releases were made in 32 sites, with up to five release points at each site. All available CM natural enemies have been released in these

different sites but until now, only the establishement of *E. lopezi* has been recorded. A total of 650,000 km^2 are covered by *E. lopezi* in thirteen countries. Wherever *E. lopezi* has been established for over one dry season, CM populations have been kept below injury levels (15-25 CM/tip). Extensive monitoring operations in Nigeria have also shown that *E. lopezi* does spread rapidly, up to 170 km/year. Although *E. lopezi* is known from laboratory experiments to have a low parasitization rate (20 to 40 per cent) it is a very good control agent. It is able to overcome encapsulation by superparasitization and increase its host's mortality through host feeding. In field experiments, we have shown that where *E. lopezi* is present, the CM is kept at low densities. Physical and chemical exclusion of *E. lopezi* in experiments, allowed however, a CM population increase to damaging levels.

(e) Training

The ABCP is heavily committed to the training of biological control specialists at two levels :

(i) Extension
(ii) Higher degree (MSc. and PH.D)

From 1985 to 1989 up to 100 extension officers will be trained in biological control practices and 56 M.Sc. and Ph.D. scholarships awarded. The specialists so trained should eventually become the backbone of national and regional control programmes in Africa.

CONCLUSION

The ABCP has so far shown great potential to overcome the CM problem. Continued efforts should be made on all fronts to make it another success of classical biological control. Concerned efforts will be needed to achieve biological control of the CGM. However, the prospects are good in view of the large complex of phytoseiid species already known.

LITERATURE

IITA Annual Reports and Research Highlights 1982, 83, 84.