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ROOT CROPS IN EASTERN AFRICA

Proceedings of a workshop held in Kigali, Rwanda, 23-27 November 1980

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Root Crops in Eastern Africa

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Résumé

Cette brochure traite principalement des deux tubercules alimentaires les plus importants en Afrique orientale, soit le manioc et la patate douce. Quelques communications portent sur la pomme de terre, l'igname, le taro et l'« enset » dont la consommation est considérable dans plusieurs pays de la région. Le rendement de ces cultures est limité par de nombreux facteurs. Aussi, la recherche effectuée dans le cadre de programmes agronomiques nationaux et internationaux est-elle orientée vers la correction de cette situation en Afrique. Les difficultés rencontrées en cours de travaux et les progrès réalisés sont décrits par des représentants et des consultants de l'Institut international d'agriculture tropicale d'Ibadan (Nigéria) et d'autres pays tel que le Cameroun, le Kenya, l'Ouganda, le Malawi, le Zimbabwe, l'Éthiopie, le Burundi, le Zaïre et le Swaziland.

Resumen

Esta publicación se enfoca en la mandioca y el camote — los cultivos de tuberosas más importantes del Africa oriental. Los trabajos tratan también del *Solanum tuberosum*, *Dioscorea* spp., *Colocasia* sp., *Xanthosoma* sp., y *Enset* sp., que son todos cultivos importantes a los países de esta región. La producción de cada uno es restringida por serios constreñimientos, y el alivio de éstos es el objetivo de varias investigaciones llevadas a cabo por los programas agrícolas nacionales e internacionales en el Africa. El progreso hacia y los problemas encontrados en llegar a este fin son delineados por especialistas representando al Instituto Internacional de Agricultura Tropical en Ibadan, Nigeria, y a los países de Camerún, Kenia, Uganda, Malawi, Zimbabwe, Etiopia, Burundi, Zaire, y Swazilandia.

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Country reports

The mealybug problem and its control

T.P. Singh[1]

Although only recently introduced to Africa, the mealybug (*Phenacoccus manihoti*) has been reported to cause yield reductions of 57–85%. It is a dry-season pest and proliferates rapidly at temperatures between 27° and 29°C. It multiplies parthenogenetically, and a single female is sufficient to cause infestation. In the field, the pest is spread by wind and, over large distances, through the movement of infested planting material. Control of the pest is being investigated through both short-term (cultural and chemical) and long-term (biological and resistance-breeding) measures, and some progress has been made. For instance, studies on cultural control have revealed that early planting and mulching of the cassava crop can reduce the damage from the pest and that chemical treatment of planting material is desirable, although chemical control does not seem feasible in areas, such as Zaire, where the cassava leaves are eaten as a vegetable. Parasites and predators found in Zaire have been of little help in controlling the mealybug; therefore, biological control agents will have to come from outside the country. Resistance to mealybug has been identified both in wild and in cultivated cassava types. Some problems, however, have been encountered in the use of this resistance.

Bien qu'arrivée récemment en Afrique, la cochenille (*Phenacoccus manihoti*) a fait diminuer les rendements de 57 % à 85 %. Il s'agit d'un insecte de saison sèche qui prolifère rapidement à des températures de 27 à 29 °C. Il se multiplie par parthénogénèse et il suffit d'une femelle pour provoquer l'infestation. L'insecte se propage sur le terrain par le vent, et sur de grandes distances, par le transport de plants infestés. On étudie les mesures de lutte à court terme (agricoles et chimiques) et à long terme (biologiques et sélection en fonction de la résistance) et on a réalisé des progrès. Par exemple, les études de lutte agricole ont révélé que le manioc planté et paillé tôt résiste mieux et que le traitement chimique des plants était souhaitable bien que la lutte chimique ne soit pas toujours possible dans les pays comme le Zaïre, où l'on consomme les feuilles de manioc. Les parasites et les prédateurs trouvés au Zaïre n'ont que peu d'effet sur la cochenille et il va falloir importer les agents de lutte biologique. On a identifié la résistance à la cochenille chez des types de manioc sauvage et cultivé, mais on éprouve quelques difficultés à en tirer parti.

Mealybug (*Phenacoccus manihoti*) is one of the two pests of cassava that have become serious constraints to production in Africa during the past decade. Since it was first reported in Zaire by Hahn and Williams (1973), the pest has spread far and wide in Central and West Africa. It has been reported in Zaire, Gabon, Angola, the Congo, Nigeria, and Senegal (Hahn et al. 1978). Serious attack by the mealybug can cause a root-yield reduction of 54–85% (PRONAM 1979).

Because of the serious implications of mealybug infestation, a concerted research effort was mounted by scientists in Programme national manioc (PRONAM) to find measures to control this menace. Initially, a survey was conducted to determine the pattern of pest distribution and its severity. Studies were also initiated on the biology of the pest and the factors influencing pest populations. They revealed that the mealybug is a pest during the dry season and that its population reaches a peak when the temperature is high (27°–29°C) and relative humidity is about 65–70% (Leuschner 1977b; Nwanze 1978). The mealybug has been reported to be particularly damaging to plants growing in poor soils (Nwanze 1978). Biological studies have revealed that *P. manihoti* is female and that it multiplies parthenogenetically. A single female lays an average 440 eggs, which

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hatch in 8 days. Crawlers, which take 12 days to reach the adult stage (fourth instar), emerge and move to the upper leaves and plant tip where they are picked up by the wind and are spread throughout the field. Another means of spread is through the movement of vegetative planting material. A single gravid female is all that is necessary to initiate infestation (Nwanze 1978).

The majority (60%) of the insects are found on the under surface of the leaf, and, of these, about half (52%) are oriented on the leaf midrib, and most of the remainder are found on secondary veins. The first symptom of mealybug damage is clustering and curling of top new leaves and is called "bunchy top." The shortening of internodes follows, and this may be caused by the introduction of some kind of toxin into the plant. The final stage of pest damage is referred to as "candlestick" (Leuschner 1977b) — death of the growing point, which is covered with a white mass. Studies on root-yield losses conducted by PRONAM (1977) indicated reductions in numbers, length, and girth of roots (Table 1).

For control of the mealybug, short- and long-term approaches were envisaged. The short-term approach includes cultural and chemical means, whereas the long-term approach includes biological control and resistance breeding.

Cultural control

Because the pest is most serious on young plants subjected to water stress in the dry season, experiments were conducted to determine whether maintaining soil humidity at a high level by mulching and planting cassava early in the rainy season would help reduce mealybug damage. Results clearly showed that mulching decreased the degree of pest damage and the number of plants attacked, irrespective of method of planting (Table 2) (PRONAM 1977).

Plant age at infestation has a significant effect on root yield, especially when the infestation starts before the plants are 8 months old (PRONAM 1978). Thus, it is recommended that the crop be planted as early as possible (November–December) and that mulch be used to conserve soil moisture.

Chemical control

Chemical means of controlling the pest are considered to be much quicker and more efficient than other means, but, in Zaire, where cassava leaves are frequently eaten by the population, the spraying of cassava for mealybug protection cannot be recommended. Other factors militating against the use of

Table 1. Effect of mealybug attack on the root yield (t/ha) of two cassava varieties grown on two soils.

	02864 grown on:		
	Valley soil	Heavily eroded soil	Mpelo-Longi grown on lateritic soil
Noninfested	20.5	16.4	9.6
Mealybug infested	9.4	3.2	1.5
Yield reduction (%)	54.4	80.8	84.4

Table 2. Effect of mulch on mealybug incidence on two varieties of cassava.

		02864		Mpelo-Longi	
Treatment	Subtreatment	Pest score	Percentage attack	Pest score	Percentage attack
Ridges	Mulch	1.5	35.9	1.0	12.1
	No mulch	2.3	49.2	2.5	54.7
Flat	Mulch	1.3	32.1	1.3	16.6
	No mulch	2.3	61.0	1.9	23.6
Ridges, flat	Mulch	1.4	34.0	1.2	14.4
	No mulch	2.3	55.1	2.2	39.2

chemical control are: the high cost of the insecticides; their unavailability; and the farmers' almost complete ignorance of the safe use of chemicals and spraying equipment. However, some experiments were conducted with chemicals in treatments of cassava planting material, and the results clearly showed that preplant dipping of cassava stakes in a solution of dimethoate (500 g a.i.) (5 ml/L of water) helped to free the stakes from crawlers, although it did not give any protection against later field infestation (Nwanze 1978). The establishment of stakes after insecticide treatment was good (PRONAM 1978).

Biological control

Biological control is a new approach for the control of cassava mealybug in Africa. Preliminary work initiated in PRONAM for the biological control of mealybug has been directed toward identifying parasites and predators that are available locally and determining their efficiency in checking mealybug populations. Findings were that the most predominant predators and parasites are coccinellids and hymenoptera and that biological control of mealybugs by local species is taking place but to a limited degree. Some parasites and predators have been introduced through the Commonwealth Institute of Biological Control (CIBC), releases being made in three locations, but no recovery was possible (PRONAM 1978). The International Institute of Tropical Agriculture (IITA) has recently initiated a concerted research effort to control mealybug through the introduction of exotic parasites and predators.

Resistance breeding

A considerable amount of genetic variability in the form of seed was introduced into Zaire from IITA and other sources for screening against the mealybug. Under artificial conditions, three wild cassava plants resistant to mealybug were identified (PRONAM 1978). These plants do not produce edible roots, however, and the normal procedure for multiplying mealybug-resistant plants failed because the stem cuttings did not root to support the sprouting buds. The plants were incorporated in a hybridization program to transfer their gene for resistance into locally adapted varieties. Some success was obtained but the seeds that resulted showed poor germination under field conditions. Grafting the mealybug-resistant plant as a scion on the stock of cultivated cassava has also been tried, with a success rate of about 10–15%.

Efforts to find an additional source of resistance, especially in cultivated cassava, are continuing, and some promising results have been obtained from another batch of cassava seed introduced from IITA. The first negative screening of 6504 individual plants under artificial infestation resulted in the identification of 123 plants with relatively little mealybug damage (PRONAM 1979). The number of plants for the scores 1–5 were 42, 1939, 1916, 1850, and 757, respectively. Five cuttings from each of the selected plants were planted in May 1980 so that their level of resistance could be confirmed. Each plant in a row was infested artificially in August, and the clones were screened in October before the rains. Of 104 clones, 34 (32.7%) showed pest scores of between 1 and 2, whereas the local variety (02864), planted as a check, always showed a score of 4. Of these 34 clones, 12 showed a score of 1–1.5. Thus, the potential for finding a source of resistance to mealybug is good.

The efforts made so far in PRONAM on the control of mealybugs suggest that a long-lasting solution to the menace is in sight and can be achieved through an integrated control approach.