Nematicidal treatment of banana AAA cv. Poyo planting material by corm coating

Thierry MATEILLE, Patrick QUÉNÉHERVÉ and Patrick TOPART

Laboratoire de Nématologie, Centre ORSTOM, B.P. V51, Abidjan, Côte d'Ivoire.

SUMMARY

The chemical treatment of banana cv. Poyo planting material by coating with one of the four systemic nematicide products : carbofuran, phenamiphos, isazophos and aldicarb, employed at 2 g per corm, or with a fumigant (dibromochloropropane) at 1.3 ml per corm, prevents rapid development of nematode populations *(Radopholus similis, Hoplolaimus pararobustus* and *Cephalenchus emarginatus)* after planting. The nematicidal activity lasts for about three to four months. The systemic nematicides controlled parasites by direct contact during their migration through the coating and in the soil after the dissolution of the products in it, or in roots by systemic effects. All products, except dibromochloropropane, reduced the population levels, but their efficacies differed according to the nematode species. This trial also shows that population fluctuations of all nematode species depend on the climatic seasons : the parasite populations declined in the roots during the dry seasons.

RÉSUMÉ

Traitement nématicide du bananier AAA cv. Poyo à la plantation par pralinage des souches

Le pralinage des souches de bananier cv. Poyo à l'aide, soit d'un nématicide systémique (carbofuran, phenamiphos, isazophos ou aldicarbe) à la dose de 2 g par souche, soit d'un nématicide fumigant (dibromochloropropane) à la dose de 1,3 ml par souche, empêche le développement instantané des populations de nématodes majoritairement présents (*Radopholus similis, Hoplolaimus pararobustus* et *Cephalenchus emarginatus*). La durée d'action des nématicides est de trois à quatre mois. Les nématicides systémiques agissent sur les différents nématodes *i)* par contact direct soit dans le sol, soit pendant leur passage à travers la couche de pralinage dans le cas de *Radopholus similis,* ou *ii)* après absorption par les racines. Tous les produits utilisés retardent le développement des populations de nématodes, mais ils présentent des efficacités différentes et n'agissent pas de la même façon selon le genre considéré. La pluviosité a une influence très nette en diminuant les niveaux de population de tous les nématodes rencontrés; les périodes de sécheresse favorisent au contraire la pullulation des parasites.

The presence of nematodes inside the cortex of banana rhizomes (Blake, 1972; Quénéhervé & Cadet, 1985*a*), presents the problem of spread of these parasites and of their introduction into nematode-free areas after planting corms and suckers. Apart from the use of vitro-plants (Vuylsteke & De Langhe, 1985), the only techniques employed up to now to eradicate those sources of infestation without adversely affecting the planting material were mechanical treatments by paring corms and suckers (Loos & Loos, 1960; Broadley, 1979), physical treatments by drying outer corms cortex under sun (Quénéhervé & Cadet, 1985 *b*), dipping them in hot water (Melin & Vilardebó, 1973; Broadley, 1979), chemical treatments by dipping (Jones & Reynolds, 1980) or coating (Guérout, Vilardebó & Sanogo, 1965; Guérout, 1975) corms of suckers.

Nowadays, availability of new systemic nematicides indicates the need for bringing banana corm coating up to date. Therefore, the present study, carried out in the Ivory Coast, compared the efficacy and mode of action of four new systemics and one fumigant applied in this way on populations of *Radopholus similis, Hoplolaimus pararobustus* (endoparasitic nematodes) and *Cephalenchus emarginatus* (ectoparasitic nematode).

Material and methods

The trial was set out on beds, separated by drains, on an industrial plantation in Azaguié (Ivory Coast), in a wet sandy-loam soil already planted with banana trees.

The experiment lasted from April 1983 to February 1984, a period with four very distinct and alternating climatic seasons : rainy seasons from April to June (628 mm) and from September to December (375 mm), dry seasons in July and August (32 mm) and in January and February (30 mm).

Each bed consisted of four rows of 60 planted banana corms, 2.5 m apart. Spacing of corms within rows was 2.35 m. The corms were coated in a sticky loam-sandy mud (9.7 % of 0-2 µm clay, 11.3 % of 2-20 µm silt, 20.5 % of 20-50 µm silt, 38.2 % of 50-200 µm sand and 16.3 % of 200-2 000 µm sand). Each corm could export an average weight of 500 g of mud. One fumigant and

four new systemic nematicides available in the Ivory Coast were added to the mud :

a) dibromochloropropane (DBCP) at 1.3 ml per corm;

b) carbofuran (Furadan Flow 4 F) at 2 g per corm;

c) isazophos (Miral 500 EC) at 2 g per corm;

d) phenamiphos (Nemacur 400 EC) at 2 g per corm;

e) aldicarb (Temik 10 G) at 2 g per corm.

For the control, coating was made with mud only. Banana trees received no further treatment during the experiment.

During the first cycle of culture (production of the first bunch), soil, roots and corm cortex were sampled by Quénéhervé and Cadet's method (1986) in each banana-bed. Nematodes were extracted from the soil with Seinhorst's (1962) elutriator and from roots and cortex with a mist-chamber (Seinhorst, 1950).

We compared the efficacies of nematicide products by following the development of nematode populations in the soil and within the roots of each organ of the banana trees (corms and first cycle suckers).

Results

Soil sampling before planting showed that among the main nematodes noted, the average population in ten samplings was composed of 4 896 *Cephalenchus emarginatus*, 860 *Hoplolaimus pararobustus*, 284 *Helicotylenchus multicinctus*, 164 *Radopholus similis* per dm^3, whereas the cortex were monospecifically infested by *R. similis* at the rate of 20 nematodes per gram (average rate for ten samplings) corresponding to a population of 25 000 to 50 000 nematodes per corm according to Quénéhervé and Cadet (1985*a*).

Throughout the growing period, *H. multicinctus* did not develop. Only *R. similis* and *H. pararobustus* were present but we noticed that all products tested for coating had a real nematicidal action by reducing root infestation of these nematodes. The residual action reached three to four months and was similar between the treatments.

After August, differences of infestation between treated and untreated banana trees were far less promi-

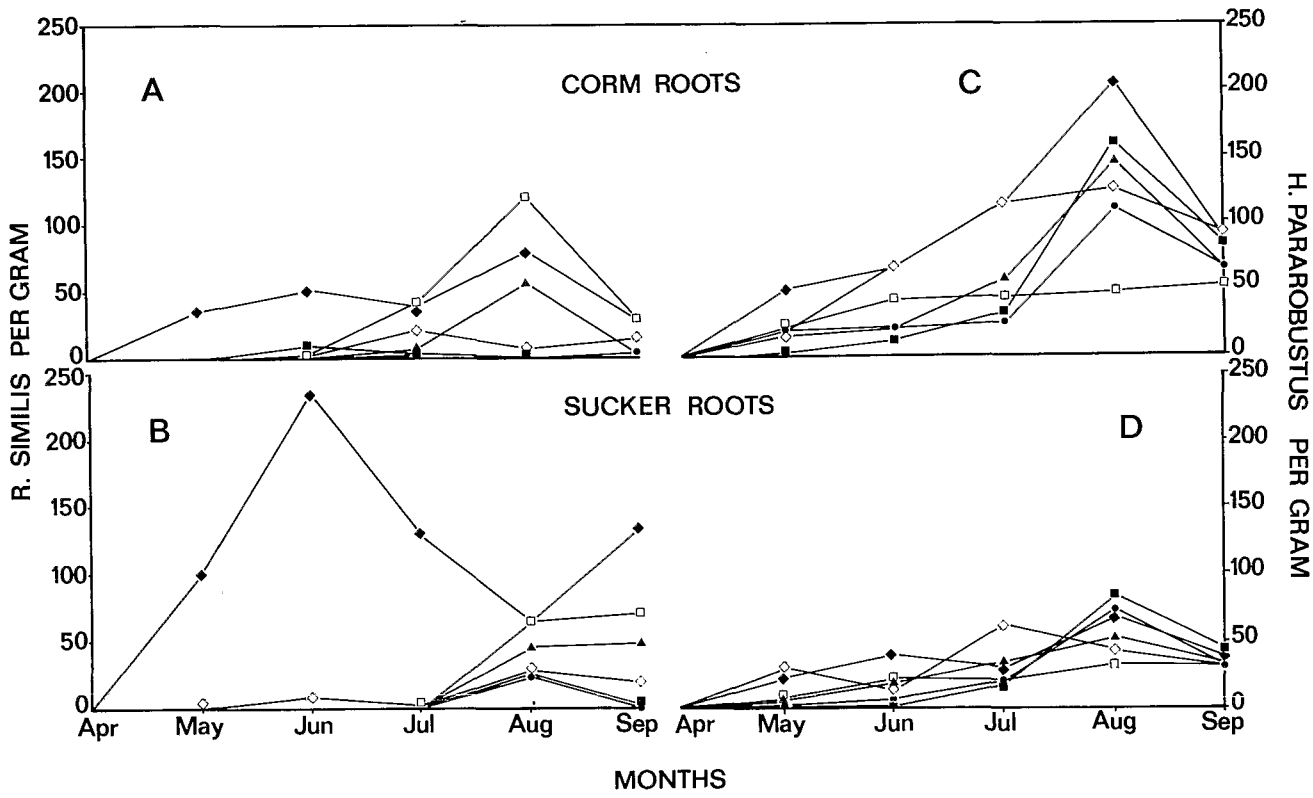

Fig. 1. *R. similis* and *H. pararobustus* population dynamics in corm and sucker roots. Legend : ♦ Control. ◊ 1.3 ml of dibromochloropropane per corm. ■ 2 g of carbofuran per corm. □ 2 g of isazophos per corm. ● 2 g of aldicarb per corm. ▼ 2 g of phenamiphos per corm.

nent; nevertheless, dibromochloropropane and aldicarb appeared to have maintained a lower total rate of parasitism than other treatments.

COMPARISON OF THE EFFECTS OF THE NEMATICIDES ON ROOT INFESTATION, AND RELATIONSHIP WITH THE ORIGIN OF THE ROOTS ON THE DIFFERENT ORGANS (CORMS OR SUCKERS)

DEVELOPMENT OF ROOT INFESTATION BY ENDOPARASITIC NEMATODES

We compared the effects of treatments on the development of nematode populations from the main sources of infestation : *R. similis* from planting material and *H. pararobustus* from soil. Results are presented for the period described above during which products persist (April to September).

Radopholus similis

In the control corms as well as in the treated ones, the population decreased by about 90 % after planting, agreeing with the observations of Quénéhervé and Cadet (1985*b*).

In roots produced by corms (Fig. 1 A), infestation appeared on the controls from the first month. *R. similis* attacked roots of treated corms from the second month at different levels and speeds according to treatments : carbofuran and aldicarb gave very good protection, followed by dibromochloropropane. Isazophos acted more briefly and, with this treatment, the infestation of corms roots rapidly reached the control level.

In roots of first-generation suckers (Fig. 1 B), *R. similis* could be observed from the first month on untreated banana trees, but it appeared on corm-coated banana trees from the fourth month only. Treatments were equivalent on those roots, and had similar efficacies.

Between June and September we observed that the population decreased in untreated banana trees.

Hoplolaimus pararobustus

On the control, it infested roots of corms and suckers from the first month but to a lesser degree in the suckers (Fig. 1 C and 1 D).

Coating with dibromochloropropane was not effective in corm roots (Fig. 1 C). Other treatments gave a three months protection. In this case also a decrease of infestation was observed after August.

In sucker roots (Fig. 1 D), infestation rates remained low and all treatments were equivalent.

ACTION OF TREATMENTS ON NEMATODE POPULATIONS IN THE SOIL

Only *H. pararobustus* and *C. emarginatus* were found in the soil during the growing season. *R. similis* was detectable in very small numbers. Figure 2 shows that all treatments applied by corm coating decreased the populations of *H. pararobustus* and *C. emarginatus*, but after July we noted a decrease of the populations of these two parasites in untreated plots.

Discussion and conclusions

From planting to harvesting, differences in distribution in root systems were observed between *H. pararobustus* and *R. similis*. Populations of *H. pararobustus* are numerous in the soil; after corm planting, the first roots grown from corms are very rapidly colonized. Meanwhile, *R. similis* infests the sucker roots from the soil and from the cortex of corms. Consequently, the distribution of the parasites seems to be related to the chronology of emergence of the two root systems (roots of corms first, then roots of suckers).

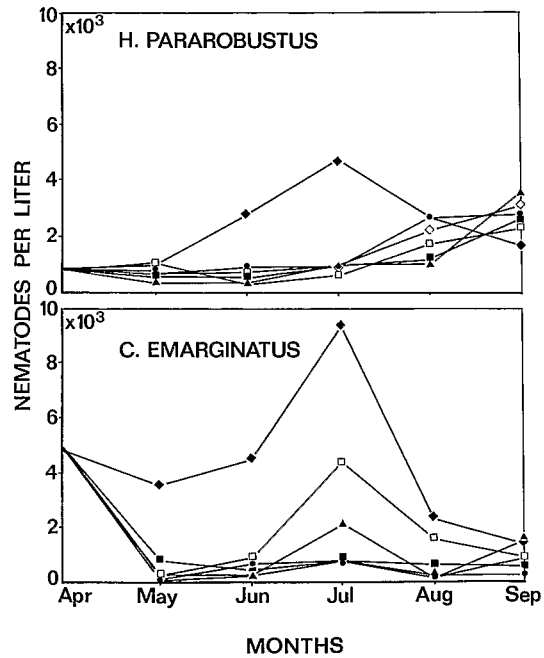

Fig. 2. *H. pararobustus* and *C. emarginatus* population dynamics in the soil.

However, as described by Mateille, Cadet and Quénéhervé (1984), this distribution might also be related to a preference of nematodes towards the roots of the different organs of the banana tree.

All nematicides applied to the cortex surface acted either directly on *R. similis* (Quénéhervé & Cadet, 1985*b*) when the parasites emerged in the soil, thus decreasing the soil inoculum, or after root absorption, reducing reinfestation of the roots of corms and suckers. All products used proved to be comparable, and the fumigant (dibromochloropropane) was also very effec-

tive again *R. similis* when used in corm coating (Vilardebó & Robin, 1969; Guérout, 1972).

The action of nematicides on *H. pararobustus* is very different; though we observed the same persistence as while, *R. similis* infests the sucker roots from the soil and were far less efficacious and dibromochloropropane was ineffective. Differences in root infestation observed between a fumigant and other so-called " systemic " products can be accounted for only by the modes of action that are peculiar to those two classes of products : dibromochloropropane acts locally only on the corm surface and temporarily on populations in the soil, whereas other products are likely to be absorbed by roots.

C. emarginatus, a strict ectoparasite, greatly decreased after planting which can be accounted for either by contact action of products used on nematodes present in the soil, or by their systemic effect after absorption in roots.

It is more difficult to measure the period of persistence of these products. However, we could estimate it to be three to four months after planting as, after this time, all populations are at the same level, whatever the treatment applied. But we notice a natural decrease of populations infesting untreated banana trees. This decrease is probably caused by the heavy rainfall (628 mm) occurring between May and June. Consequently, this makes it impossible to determine the levels populations might have reached on treated and untreated banana trees, and thus to appraise more precisely the period of persistance of these products.

The inactivity of dibromochloropropane against *H. pararobustus* shows that it is inadvisable to reduce the effective but phytotoxic dosage (1.5 ml per corm) employed by Guérout, Vilardebó and Sanogo (1965).

ACKNOWLEDGMENTS

We thank the COFRUITEL (Ivory Coast) for its technical support in carrying out this work and Mrs. C. Fauquet and Dr. J. F. Southey for the English translation of the manuscript.

RÉFÉRENCES

BLAKE, C. D. (1972). Nematode diseases of banana plantations. In : Webster, J. M. (Ed.). *Economic nematology*. London & New York, Academic Press : 245-267.

BROADLEY, R. A. (1979). Nematicide treatment of banana planting material. *Aust. J. exp. Agric. anim. Husbandry*, 19 : 631-633.

GUÉROUT, R. (1975). Banana corm coating with nematicidal mud : a preplant treatment. *Nematropica*, 5 : 22.

GUÉROUT, R., VILARDEBÓ, A. & SANOGO, M. (1965). Traitement par pralinage des souches de bananiers. Effets phytotoxiques et actions nématicides. *C. R. Trav. Congr. Protect. Cult. trop., Marseille, 23-27 mars 1965 :* 685-688.

JONES, R. K. & REYNOLDS, R. E. (1980). The control of *Radopholus similis*, burrowing nematode, in banana planting material. *Subtropica*, 1 : 9-12.

LOOS, C. A. & LOOS, S. B. (1960). Preparing nematode-free banana " seed ". *Phytopathology*, 50 : 383-386.

MATEILLE, T., CADET, P. & QUÉNÉHERVÉ, P. (1984). Influence du recépage du bananier " Poyo " sur le développement des populations de *Radopholus similis* et d'*Helicotylenchus multicinctus*. *Revue Nématol.*, 7 : 355-361.

MELIN, P. & VILARDEBÓ, A. (1973). Nématicide et désinfection à l'eau chaude dans la lutte contre *Radopholus similis* en bananeraie. *Fruits*, 28 : 843-849.

QUÉNÉHERVÉ, P. & CADET, P. (1985*a*). Localisation des nématodes dans les rhizomes du bananier cv. Poyo. *Revue Nématol.*, 8 : 3-8.

QUÉNÉHERVÉ, P. & CADET, P. (1985*b*). Étude de la dynamique de l'infestation en nématodes transmis par les rhizomes du bananier cv. Poyo en Côte d'Ivoire. *Revue Nématol.*, 8 : 257-263.

QUÉNÉHERVÉ, P. & CADET, P. (1986). Une nouvelle technique d'échantillonnage pour l'étude des nématodes endoparasites du bananier. *Revue Nématol.*, 9 : 95-97.

SEINHORST, J. W. (1950). De betekenis van de toestand van de grond voor het optreden van aantasting door het stengelaaltje (*Ditylenchus dipsaci* (Kühn) Filipjev). *Tijdschr. Pl. Ziekt.*, 56 : 291-349.

SEINHORST, J. W. (1962). Modifications of the elutriation method for extracting nematodes from soil. *Nematologica*, 8 : 117-128.

VILARDEBO, A. & ROBIN, J. (1969). Nematicidal treatment of planting material. In : Peachey, J. E. (Ed.). *Nematodes of tropical crops*. St Albans, UK, Commonw. Agric. Bur. : 133-141.

VUYLSTEKE, D. & DE LANGHE, E. (1985). Feasability of *in vitro* propagation of bananas and plantains. *Trop. Agric., Trinidad*, 62 : 323-328.

Accepté pour publication le 22 avril 1987.