Population of nematodes in soils under banana, cv. Poyo, in the Ivory Coast. 4. Seasonal dynamics of populations in organic soil

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SUMMARY

The dynamics of nematode populations of bananas have been monitored during two vegetatives cycles on two sites located on " organic soil " (clay soil and peat soil) in the banana producing area of the Ivory Coast. On this soil type the main endoparasitic nematode which occurred at a high level in the soil and in the roots is the spiral nematode, *Helicotylenchus multicinctus.* In these optimal conditions of soil type for *H. multicinctus,* the rainfall in respect to soil moisture appears as the only factor involved in the dynamics of *H. multicinctus;* whereas for *Radopholus similis,* the competition with the other nematodes species seems the most important factor involved in its dynamic beside the other factors observed on mineral soil such as the renovation of the root system and the rainfall.

RÉSUMÉ

Populations de nématodes associés à la culture du bananier cv. Poyo en Côte-d'Ivoire. 4. Dynamiques de populations saisonnières sur sols organiques

Les dynamiques de populations de nématodes associés au bananier ont été suivies sur deux sites en sols organiques (sol argileux et sol tourbeux) de culture bananière en Côte-d'Ivoire. Sur ce type de sol, le principal nematode endoparasite présent en très grand

Table 1

Granulometric and chemical characteristics of soil of the two sites studied

	Site 1 (Agbo)	*Site 2 (Yace)*
% Clay 0-2 µm	61.2	0
% Silt 2-20 µm	20.3	0
% Silt 20-50 µm	0.2	0
% Sand 50-200 µm	0.2	0
% Sand 200-2 000µm	0.2	0
% H_2O	3.0	*
% Org. Matter	14.2	*
pH H_2O	4.0	3.4
pH KCl	3.0	*
‰ C	109.5	397.3
‰ C	5.5	15.5
C/N	20.1	25.6

(*) Missing data.

banana rhizomes were sampled and analysed according to the method described by Quénéhervé and Cadet (1986) with six replicates per sampling date. Standardized extraction techniques were used for soil (Seinhorst, 1962) and roots (Seinhorst, 1950).

Results of infestation are expressed as nematode densities per dm^3 of soil and per gram of root or corm, belonging to the mother plant or bullhead (RPM, EPM), of the first principal sucker (R1Y, E1Y), of the second principal sucker (R2Y, E2Y), of the pruned suckers (R2YO, E2YO), etc. In order to have the level of infestation corresponding to the whole plant for each sampling, a " global root infestation " was calculated as a mean of the partial infestations on the different parts of the root system.

Rainfall records were collected daily on each site. A canopy level irrigation occurred in the dry season (about 24 mm per irrigation and per week). Three months after planting, the number of days of rainfall and the total rainfall (irrigation included) in a two, three, four, five,

species, *Helicotylenchus multicinctus* (Cobb, 1893) Golden, 1956, *Radopholus similis* (Cobb, 1893) Thorne, 1949 and *Hoplolaimus pararobustus* (Sch. Stek. & Teun., 1938) Sher, 1963; one ectoparasitic species : *Cephalenchus emarginatus* (Cobb, 1893) Geraert, 1968.

H. pararobustus was encountered very sporadically in soil and root samples, so for the sake of clarity the dynamics are not illustrated in the figures.

Monthly amount of irrigation in dry seasons are illustrated on the same figure as the rainfall records.

Helicotylenchus multicinctus

H. multicinctus was the main endoparasitic nematode to occur on site 1 and fluctuation in numbers of nematodes from soil showed two different parts; the first vegetative cycle with a soil infestation below 5 000 nematodes per dm^3 of soil, and the second vegetative cycle with a soil infestation which had built up to 61 600 in Aug. 82. In these conditions several major peaks were observed, coinciding for some of them with heavy rainfall periods (Fig. 1, A & B).

In the roots (Fig. 2, A-D), high levels of infestation by the spiral nematode occurred very rapidly either from pruned or unpruned suckers. For example, in the roots of the first sucker (Fig. 2, B), fluctuations showed two peaks (Nov. 81 and Apr. 82) which coincided with heavy rainfall periods. One can observe that the peaks of infestation by the spiral nematode occurred at the same period for the first vegetative cycle whatever the sucker, but infestation seemed more erratic for the second vegetative cycle.

The global root infestation reflecting the level of infestation of the whole root system of the banana plant (Fig. 1, D), showed four peaks, two in rainy seasons (Oct. 81 and Apr. 82) and two in dry season (Aug. 82 and Dec. 82).

One can observe (Fig. 3, A-D) that *H. multicinctus* have colonized the cortical part of the corm after infestation by *R. similis* whatever the suckers. *R. similis* and *H. multicinctus* were the only species constantly found in the corms. As the infestation level of *H. multicinctus* in the corm was increasing, simultaneous infestation by *R. similis* decreased.

which also coincided with the flowering of the main sucker.

If the infestation of the roots by *R. similis* remained very low by comparison with that which occurred with *H. multicinctus*, it is important to note the high level of infestation of the cortical part of the corm by *R. similis* rapidly after the sucker emergence, with increasing levels on each successive sucker whatever the season, till 395 nematodes per gram of corm in the sucker of third generation (Fig. 3, A-D). There was no correlation between root infestation by *R. similis* and soil population or the number of days of rainfall or total rainfall.

Cephalenchus emarginatus

Soil infestation by *C. emarginatus* showed only one noticeable peak in Jul. 82 (Fig. 1, C). There were significant positive correlations found between population level of *C. emarginatus* and *i)* the total rainfall in a three week period before sampling ($P = 0.001$; $r = 0.711$), and *ii)* the number of days of rainfall in a four week period before sampling ($p = 0.001$; $r = 0.719$).

SEASONAL FLUCTUATION OF NEMATODE ON SITE 2 (YACE)

On site 2 (pure peaty soil) the same four nematode species were found associated with bananas as on site 1 : three endoparasitic species *(H. multicinctus, R. similis, H. pararobustus)* and one ectoparasitic species *(C. emarginatus).*

Helicotylenchus multicinctus

Fluctuations in number of *H. multicinctus* from soil showed several peaks and seemed very erratic (Fig. 4, C).

The infestation of the roots occurred very early, as soon as the root emergence (Fig. 5, A-D). This infestation was very important in number, with an average of 350 nematodes per gram of roots on the main sucker, remained at a very low level during the two vegetative cycles in comparison with *H. multicinctus.* The fluctuation in the soil showed only two small peaks, in Jan. and Sept. 83.

In the roots (Fig. 5, A-D), the infestation by the burrowing nematode reached small peaks just after the emergence of roots on unpruned and pruned suckers, except for the first sucker where the peak of infestation was delayed for four months occurring in Aug. 82.

The global root infestation (Fig.4, D) showed a decreasing level of infestation by *R. similis* from the first to the second vegetative cycle; the two peaks of infestation were occuring in relative dry seasons (Aug. 82 and Jan. 83) during the first vegetative cycle.

There was no correlation between root infestation by *R. similis* and soil population or the number of days of rainfall or total rainfall.

Hoplolaimus pararobustus

H. pararobustus was scarcely present in the soil during the first vegetative cycle, and more frequently for the second vegetative cycle, but infestation level remained very low by comparison with the other species encountered, except *R. similis* (Fig. 4, C).

In the roots (Fig. 5, A-D), an average of only ten nematodes per gram was observed in all suckers, pruned or unpruned. The global root infestation did not show any noticeable peak.

There was no correlation between root infestation by *H. pararobustus* and soil population or the number of days of rainfall or total rainfall.

Cephalenchus emarginatus

Soil infestation by *C. emarginatus* was very important (an average of 3 000 nematodes per dm^3 of soil) and seemed very erratic with successive peaks (Fig. 4, C).

There was no correlation between population levels of

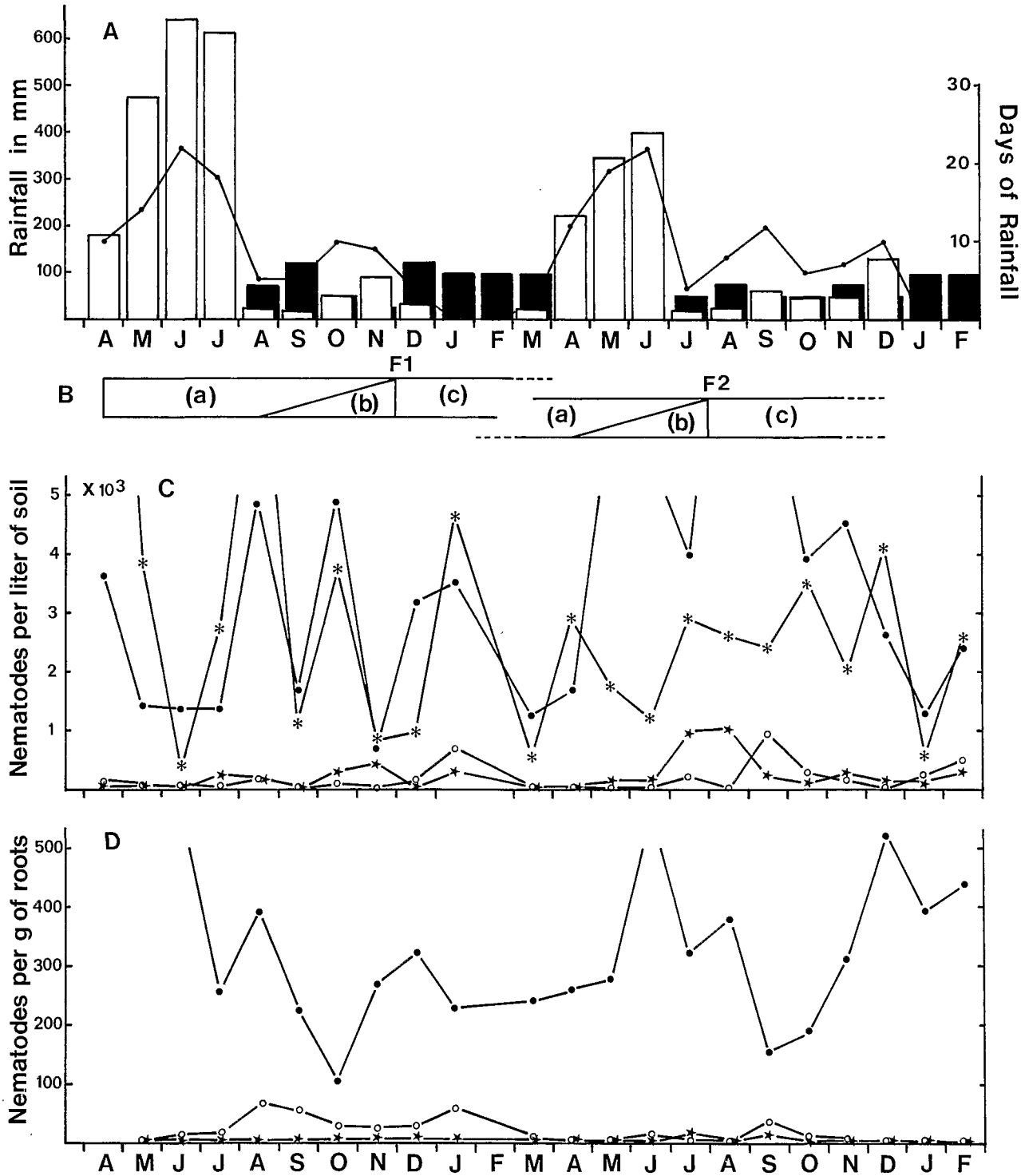


Fig. 1. Nematode population dynamics on site 1 (Agbo). A : Rainfall and irrigation (white bar : monthly rainfall; black bar : monthly irrigation; black circles and plain line : number of days of rainfall per month). B : Schematic representation of physiological stages of banana plant : (a) vegetative phase; (b) fruiting phase; (c) ripening phase; F 1, shot fruit of the plant crop; F 2, shot fruit of the first ratoon. C : Seasonal fluctuation in the soil. D : Seasonal fluctuation of the global root infestation [o : *Radopholus similis;* • : *Helicotylenchus multicinctus;* * : *Cephalenchus emarginatus;* ⋆ : *Hoplolaimus pararobutus*].

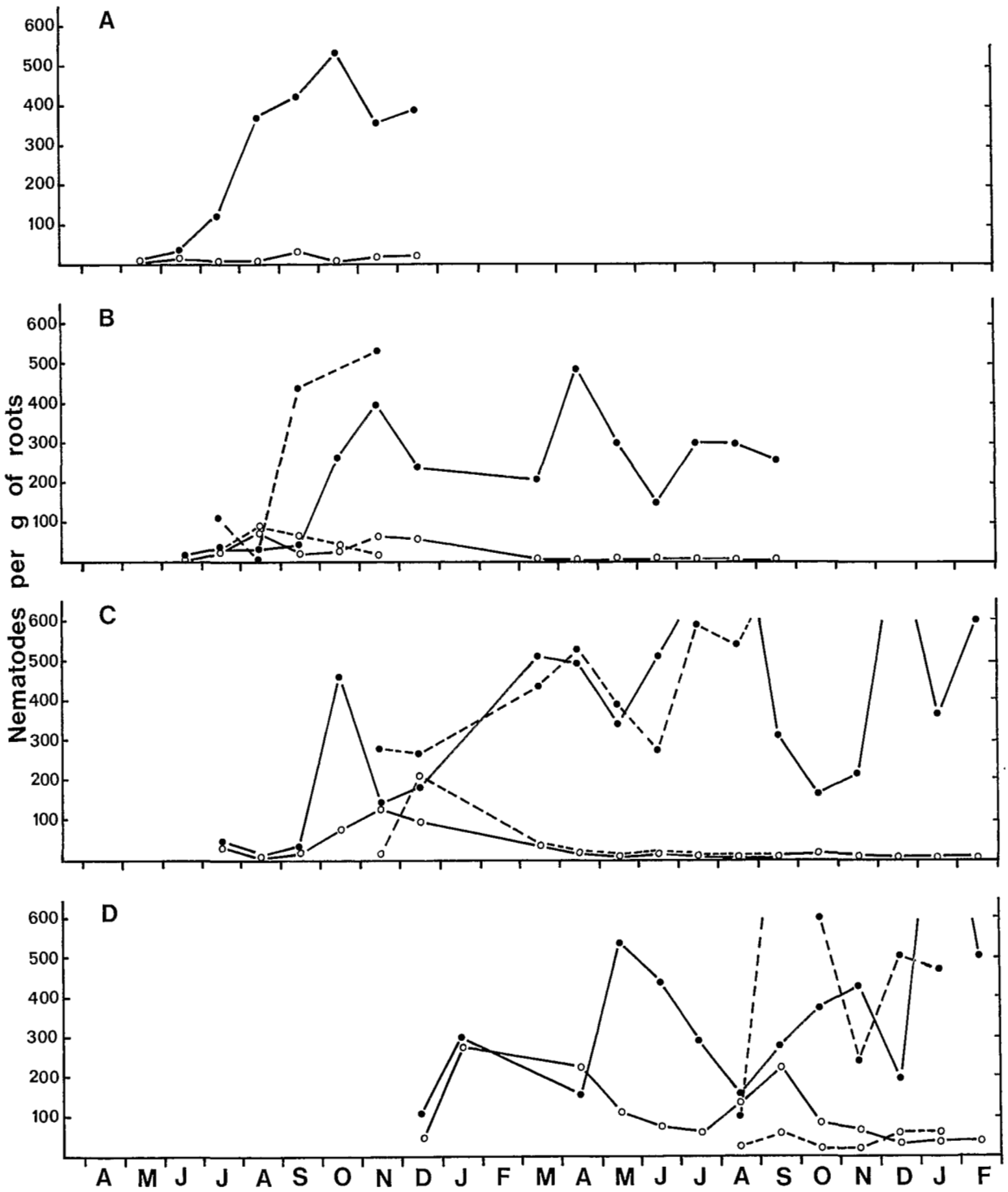


Fig. 2. Nematode population dynamics in the roots on site 1 (Agbo). A : Seasonal fluctuation in the roots of the mother plant. B :

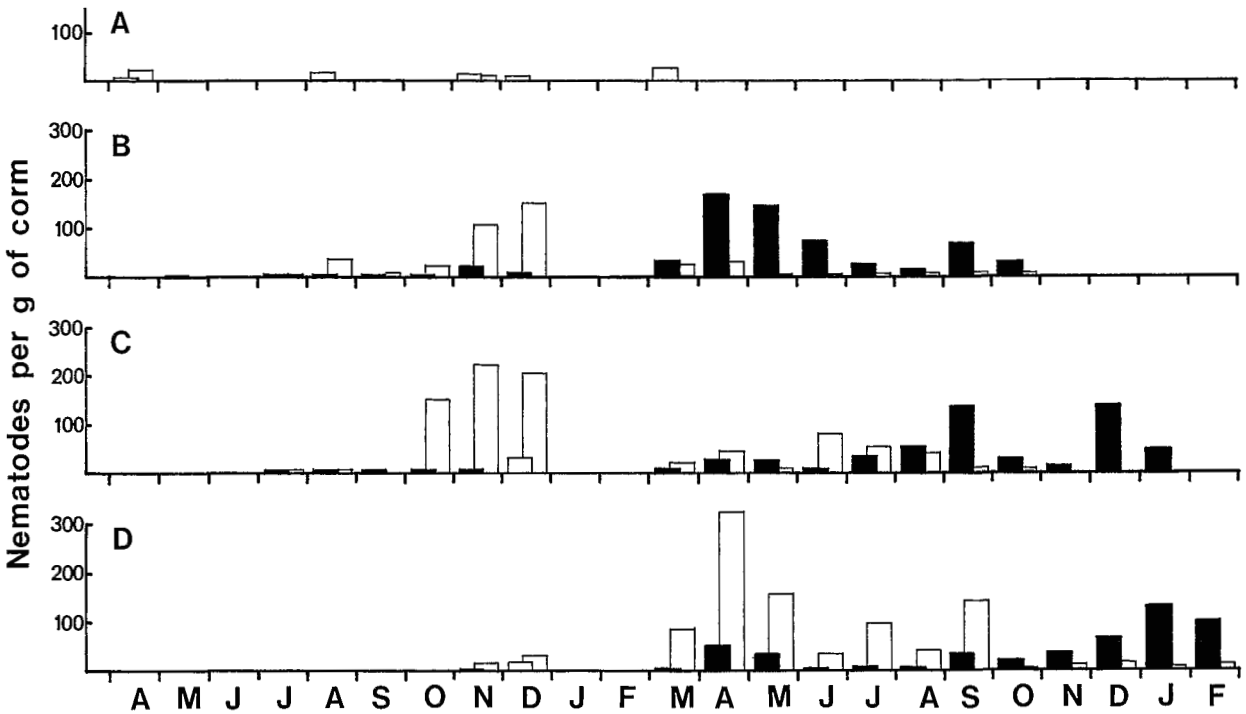


Fig. 3. Nematode population dynamics in the corm on site 1 (Agbo). A : Seasonal fluctuation in the corm of the mother plant. B : Seasonal fluctuation in the corm of the first suckers. C : Seasonal fluctuation in the corm on the second suckers (first ratoon). D : Seasonal fluctuation in the corm of the third suckers (second ratoon) [white bar : *Radopholus similis;* black bar : *Helicotylenchus multicinctus*].

invader : *i)* more closely related to the successive root stage of the banana plant or climatic factors as tempera

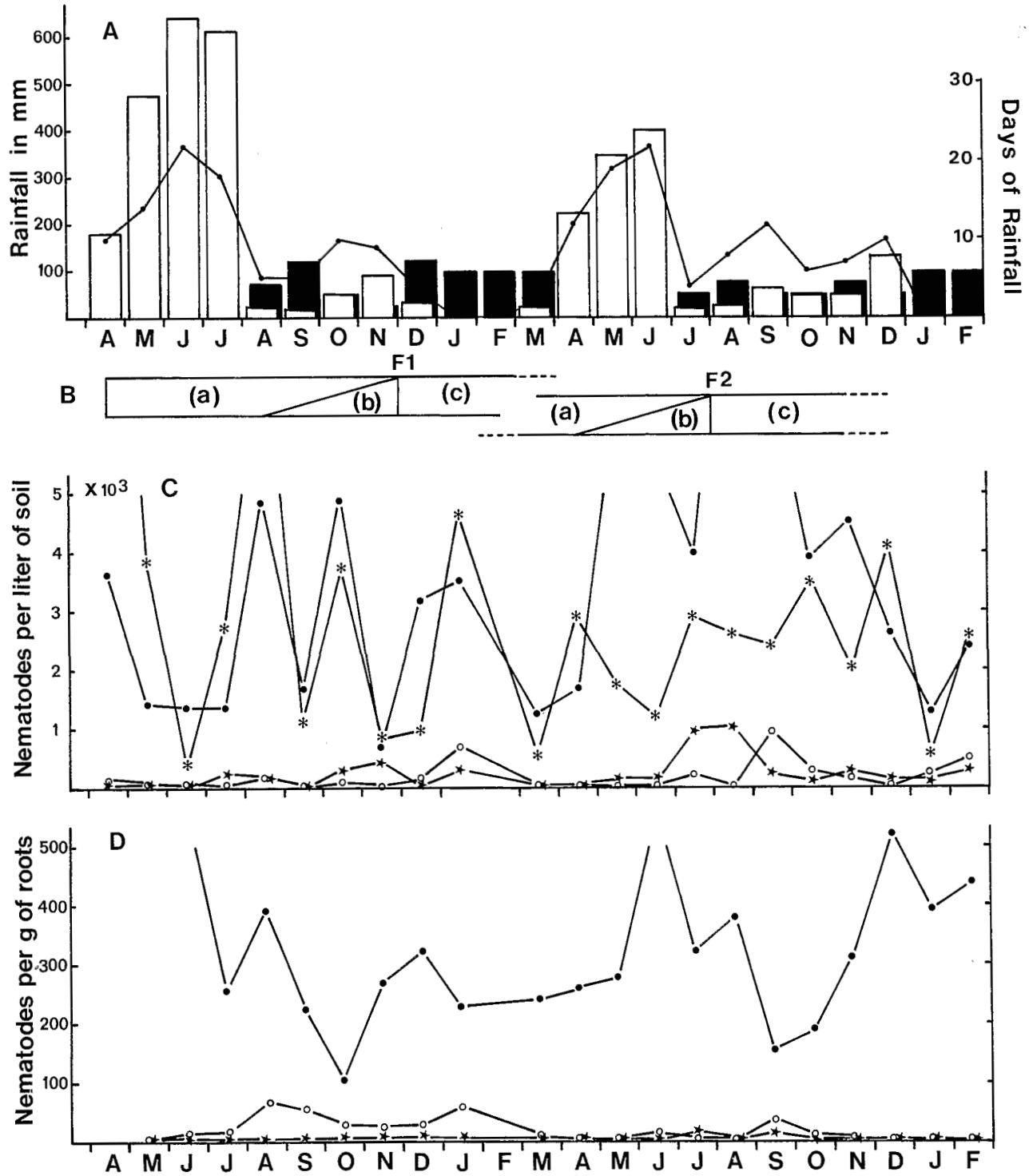
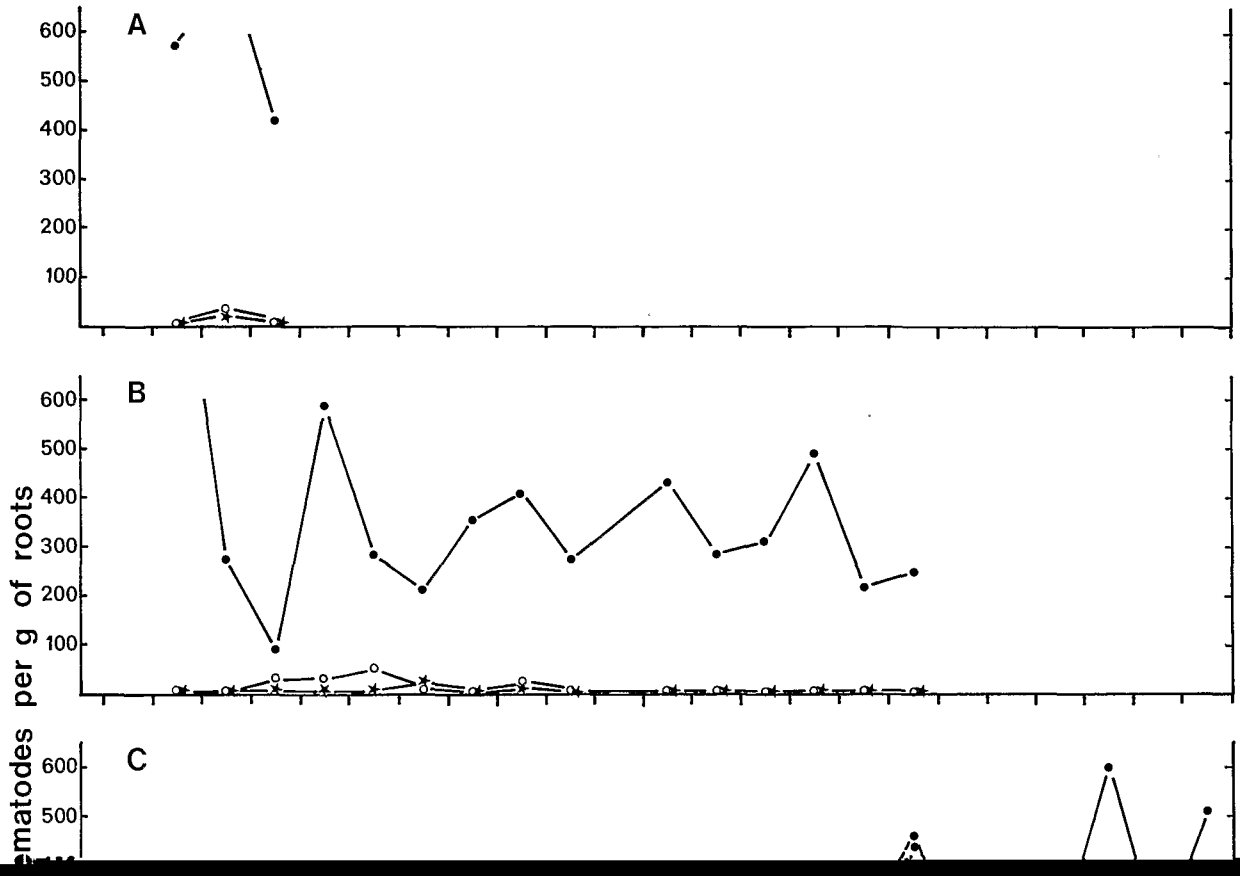


Fig. 4. Nematode population dynamics on site 2 (Yace). A : Rainfall and irrigation (white bar : monthly rainfall; black bar : monthly irrigation; black circles and plain line : number of days of rainfall per month). B : Schematic representation of physiological stages of banana plant : (a) vegetative phase; (b) fruiting phase; (c) ripening phase; F 1, shot fruit of the plant crop; F 2, shot fruit of the first ratoon. C : Seasonal fluctuation in the soil. D : Seasonal fluctuation of the global root infestation [o : *Radopholus similis;* • : *Helicotylenchus multicinctus;* ⋆ : *Hoplolaimus pararobustus;* * : *Cephalenchus emarginatus*].


A
B
C
600
500
400
300
200
100
per g of roots

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