

Responses of adult *Hirschmanniella oryzae* towards different plant roots

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SUMMARY

Experiments were performed to study the host preference behaviour of *Hirschmanniella oryzae* and to observe the effects of plant root homogenate concentrations on the activity of *H. oryzae*. Attraction was tested in 0.5 % water-agar in Petri-dishes towards plant roots of cabbage, carrot, radish and onion either alone or in different combinations. The effect of 20, 40, 60, 80 and 100 % concentrations of the above plant root homogenates was observed on the activity (head movements/minute) of nematodes. Cabbage and carrot attracted most *H. oryzae* while onion the least. Similarly, homogenate concentrations of cabbage and carrot roots increased activity of nematodes but those of onion and radish suppressed it markedly. The results suggest that *H. oryzae* shows some degree of preference and attraction depends upon the host root, attractants and activity of nematodes.

RÉSUMÉ

Réactions des adultes de Hirschmanniella oryzae envers différentes plantes hôtes

Une série d'expériences a été réalisée pour étudier le comportement de *Hirschmanniella oryzae* envers différentes plantes hôtes et pour observer les effets d'homogénats de racines sur l'activité du nématode. L'attraction par les racines de chou, de carotte, de radis et d'oignon a été testée sur agar à 0,5 % dans l'eau, en boîte de Petri. Les effets de concentrations à 20, 40, 60, 80 et 100 % d'homogénats de racines des plantes précitées sur l'activité du nématode (nombre de mouvements de la partie antérieure par minute) ont été également observés. Le chou et la carotte attirent le plus *H. oryzae* et l'oignon le moins. De même, les homogénats de racines de chou et de carotte accroissent l'activité du nématode tandis que ceux d'oignon et de radis la suppriment de façon nette. Ces résultats suggèrent que *H. oryzae* montre un certain degré de préférence envers les plantes hôtes et que l'attraction dépend des racines de l'hôte, des substances attractives et de l'activité du nématode.

There is ample evidence to suggest that plant-parasitic nematodes accumulate around roots of host plants (Lownsbery & Viglierchio, 1960; 1961; Azmi & Jairajpuri, 1977; Prot & Van Gundy, 1981a; 1981b). Viglierchio (1961) found a correlation between plant attractiveness and its efficiency as a host in case of *Heterodera schachtii*. He (*l. c.*) also observed a strong attraction of *Meloidogyne hapla* juveniles towards a non-host (Kanota oat) and strong repulsion or weak attraction towards Merced Rye grass. There was no significant difference in the attraction of *Meloidogyne hapla* towards resistant and susceptible cultivars of alfalfa when tested separately but when compared simultaneously susceptible cultivars attracted more nematodes (Griffin, 1969). Lee and Evans (1973) found a strong correlation between the degree of attraction of rice seedling extract and its susceptibility to *Aphelenchoides besseyi*. Mathur and Prasad (1973), and Mohandas, Pattanik and Prasad (1979) observed the host range of rice root nematode, *Hirschmanniella oryzae*, on some commonly cultivated crops and weeds while Park, Han and Lee (1970) studied its behaviour towards different varieties of rice. The attraction and factors influencing the migration of

H. oryzae towards cabbage roots was studied by Bilgrami (1983) and Bilgrami, Ahmad and Jairajpuri (1985).

In the present work, behaviour of adult *Hirschmanniella oryzae* (van Breda de Haan) was observed towards roots of cabbage (*Brassica oleracea* L. var *capitata*); carrot (*Daucus carota* L. var *sativus*); radish (*Raphanus sativus* L.) and onion (*Allium sepa* L.) singly and in combinations of two plants. The effects of different root homogenate concentrations of the above mentioned plants on the activity of *H. oryzae* have also been observed.

Materials and methods

HOST SELECTION BEHAVIOUR

The responses of adult *H. oryzae* were observed towards roots of cabbage, carrot, radish and onion singly and towards different combinations of two hosts. All experiments were carried out in 0.5 cm thick layer of 0.5 % water-agar in the presence of 1 cm long excised

roots of 4-6 day old seedlings (Bilgrami, Ahmad & Jairajpuri, 1985). The roots before being excised were surface sterilized with 0.1 % mercuric chloride and the nematodes with 0.01 % mercuric chloride solution. All experiments were carried out at $25 \pm 1^\circ$ and replicated five times unless mentioned otherwise. Controls were run without roots.

ATTRACTION TOWARDS SINGLE HOST ROOT

Two experiments were performed to test host preference behaviour of *H. oryzae*. In the first 7 cm diameter Petri-dishes were marked at the bottom into seven equal zones of 1 cm width. These zones were numbered as 1, 2... and 7 (Fig. 1). The roots were placed in zone 1 of the Petri-dishes and left for 12 h after which twenty-five

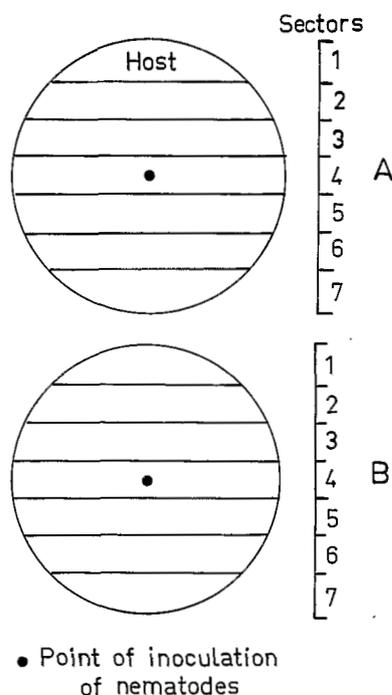


Fig. 1. Diagram showing different zones of the Petri-dish which was employed in the experiment to study the attraction of *H. oryzae* towards single host and combination of two hosts.

H. oryzae adults were introduced in zone 4. The number of nematodes present in each zone was counted after 4 h. In the second attraction was tested by the Petri-dish method (Ahmad & Jairajpuri, 1980; Bilgrami, Ahmad & Jairajpuri, 1985). A 1 cm part of excised root from a 4-6 day old seedlings was placed in the inner circle of Petri-dishes containing a 0.5 cm thick layer of 0.5 % water-agar. After 12 h five specimens of adult *H. oryzae* were placed at different points of the reference circle. The distribution of *H. oryzae* was recorded after 1, 2, 3 and 4 h and was converted into scores and log scores. Experiments were replicated fifteen times.

ATTRACTION TOWARDS DIFFERENT HOST ROOT COMBINATIONS

As above, attraction towards different root combinations was studied in Petri-dishes marked at the bottom into seven zones (Fig. 1). An excised root of one host was placed in zone 1 and that of the other in zone 7 and left for 12 h before fifty adult nematodes were introduced in zone 4. The distribution of nematodes was recorded after 4 h. The following combinations of host roots were used : cabbage and carrot; cabbage and radish; cabbage and onion; carrot and radish; carrot and onion and onion and radish.

ACTIVITY IN ROOT HOMOGENATE CONCENTRATIONS

Twenty gram of roots of 4-6 day old seedlings were surface sterilized with 0.1 % mercuric chloride and homogenized in 20 ml of sterile distilled water in a Warring blender to obtain the stock (100 %) root homogenate solutions. This solution was then filtered to remove the solid materials. From the stock solution 20, 40, 60 and 80 % dilutions were obtained. Stock solutions of homogenates of cabbage, carrot, radish and onion roots were prepared and tested separately on the activity of *H. oryzae* adults. Two ml solution from each concentration of various root homogenate taken in separate cavityblocks and five adult *H. oryzae* were placed in each. The activity of nematodes was measured in terms of head movements per minute (Bilgrami, Ahmad & Jairajpuri, 1983). The observations were made at 2, 4, 6, 8, 10 and 12 h after transferring nematodes into medium. Activity in tapwater served as control. Data of those solutions in which the activity ceased within 2 h have not been plotted.

Results

ATTRACTION TOWARDS SINGLE HOST ROOT (Fig. 2, 3 & 4)

Most of the nematodes remained near point of introduction (zone 4) in the absence of roots (Fig. 2, A). Onion and radish seedlings attracted fewer nematodes (Fig. 2, B & C) than carrot and cabbage ($p < 0.05$) (Fig. 2, D & E).

In the second experiment the distribution of adult *H. oryzae* corresponded to ranks 4, 5 and 6 in absence of roots (Fig. 3). However, in the presence of onion, radish, carrot and cabbage roots the distribution of nematodes corresponded to ranks 5, 6, 7, 9 and 10; 6, 7, 8 and 9; 10, 11, 12, 13, 14, 15, 16 and 17 and, 18, 20 and 21 respectively (Fig. 3, A, B, C & D). The nematodes showed weak responses towards onion and radish seedlings (mean log score 1.56 and 1.97 respectively, $p < 0.05$) while they responded strongly towards cabbage seedlings (mean log score 2.58, $p < 0.05$; Fig. 4).

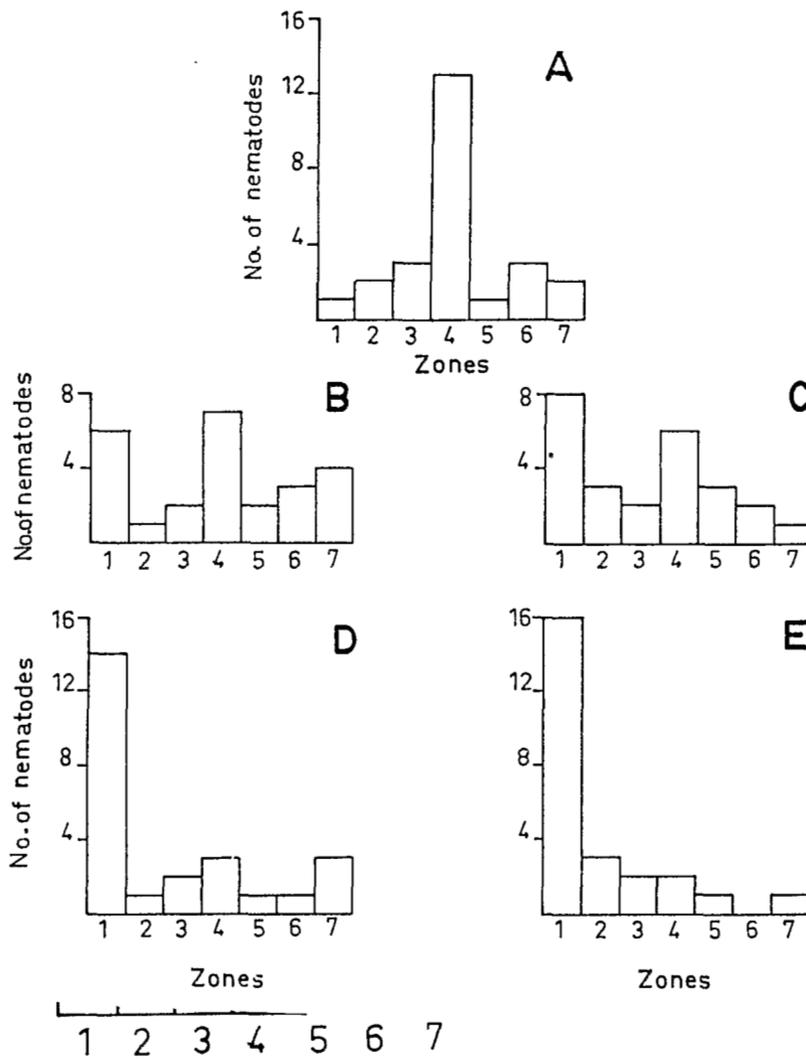


Fig. 2. Attraction of adult *H. oryzae* towards different plant roots. A : without roots; B : onion; C : radish; D : carrot; E : cabbage.

ATTRACTION TOWARDS DIFFERENT HOST ROOT COMBINATIONS (Fig. 5)

In combinations of cabbage and onion and cabbage and radish, *H. oryzae* was attracted more towards cabbage than other plant roots ($p < 0.05$) (Fig. 5, C & D) but in the combination of cabbage and carrot there was no significant difference in the attraction ($p > 0.05$) (Fig. 5, B). The roots of carrot when placed in the combination of radish (Fig. 5, E) and onion (Fig. 5, F) attracted significantly more *H. oryzae* than the latter two plants ($p < 0.05$). The differences in the attraction of nematodes in combination of radish and onion were insignificant ($p > 0.05$) (Fig. 5, G). In the absence of roots most of the nematodes remained near point of introduction (Fig. 5, A).

ACTIVITY IN ROOT HOMOGENATE CONCENTRATIONS (Fig. 6)

All concentrations of cabbage root homogenate appeared favourable for *H. oryzae*. The homogenate of 60 and 80 % stimulated activity most and the increase in activity from 2 to 12 h was significant ($p < 0.05$) (Fig. 6, A). 20, 40 and 60 % concentrations of carrot appeared to be more suitable for nematodes ($p < 0.05$). The 80 and 100 % concentrations seemed unfavourable (Fig. 6, B). All concentrations of radish and onion suppressed the activity of nematodes (Fig. 6, C & D). No activity was observed in 100 % solution of radish and onion root homogenate. The nematodes became immobile after 6 h in 80 % solution of radish and after 4 and 10 h in 80 and 60 % solutions of onion root homogenate.

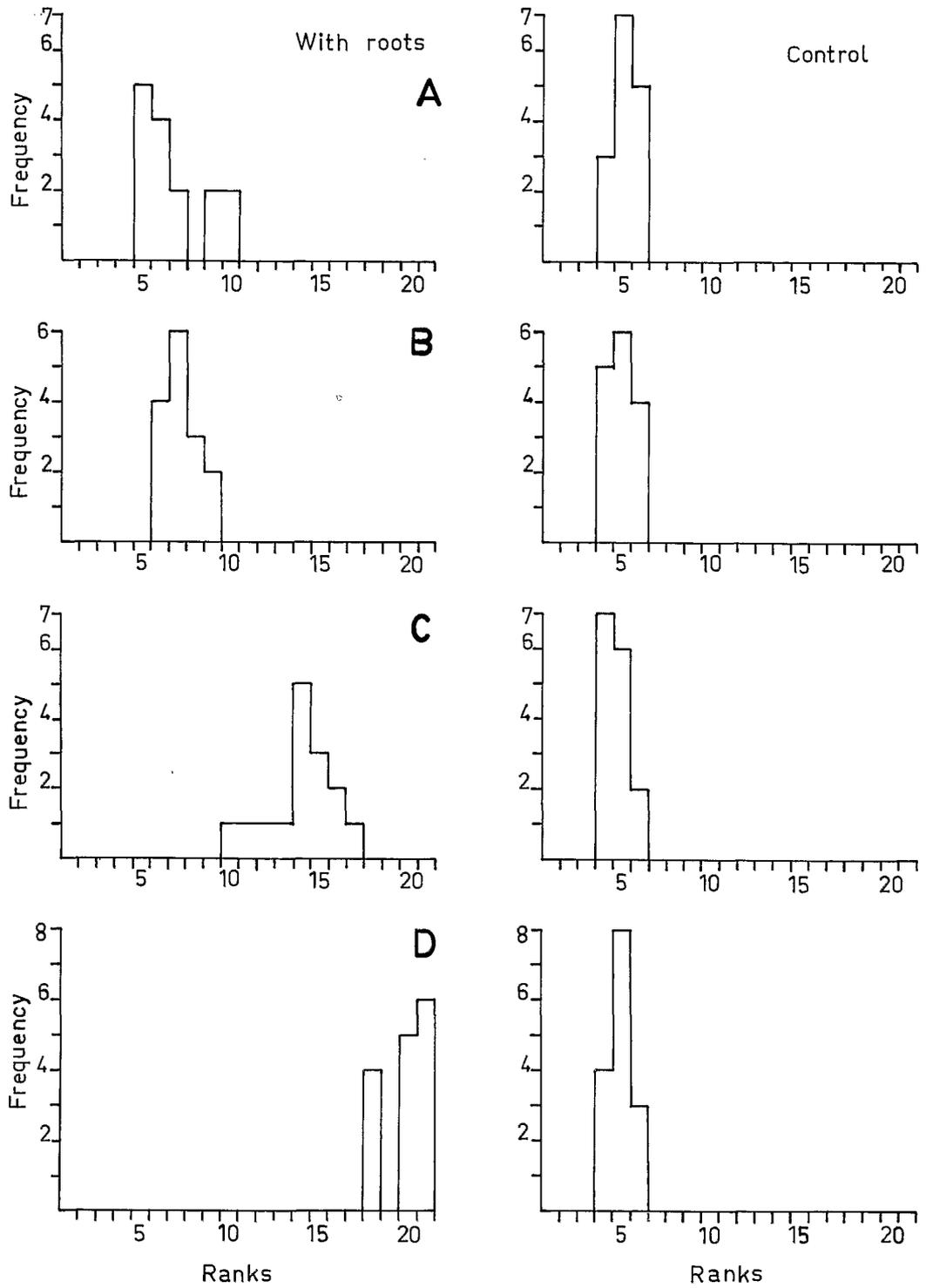


Fig. 3. Distribution of adult *H. oryzae* in presence and absence of different plant roots. A : onion; B : radish; C : carrot; D : cabbage.

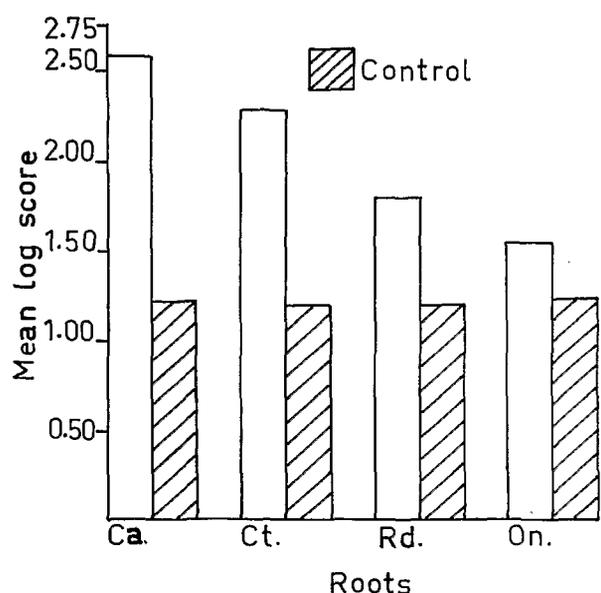


Fig. 4. Attraction of adult *H. oryzae* towards different plant roots (Petri-dish experiments). Ca : cabbage; Ct : carrot; Rd : radish; On : onion.

Discussion

Prot (1980) considered the attraction of plant-parasitic nematodes towards host roots to be non-specific. Khera and Zuckerman (1963) found no significant difference in the attraction of *Hemicycliophora similis* towards roots of host and non-host plants. However, juveniles of *Meloidogyne hapla* were attracted equally by the resistant and susceptible cultivars of alfalfa when tested separately, but when compared simultaneously susceptible cultivars attracted more nematodes (Griffin, 1969). Our observations showed that all plant roots were attractive to *H. oryzae* but these nematodes showed some degree of preference for cabbage and carrot as indicated by their distribution pattern. Cabbage was preferred most when tested separately or in different combinations of plant roots. These differences in the attraction of *H. oryzae* towards different plant roots may be attributed to the sensitivity of the nematodes to stimuli of the roots or due to the attractants themselves as all plants do not produce similar attractants (Prot, 1980).

The differential activeness of *H. oryzae* in different concentrations of various root homogenates may be attributed to the effects produced on the nematodes by the attractants and possibly by other substances present in the host roots. Luc, Lespinat and Souchaud (1969) and Prot (1975) believed that root diffusates simultaneously stimulate the rate of movement and attract the nematodes. Perhaps the same phenomenon seems to

occur in *H. oryzae* adults. The maximum attraction towards cabbage and least towards onion roots as well as enhanced activity in different concentrations of cabbage and reduced activity in onion root homogenate suggests that perhaps attraction may be directly related to the activity of nematodes, the more active being attracted more.

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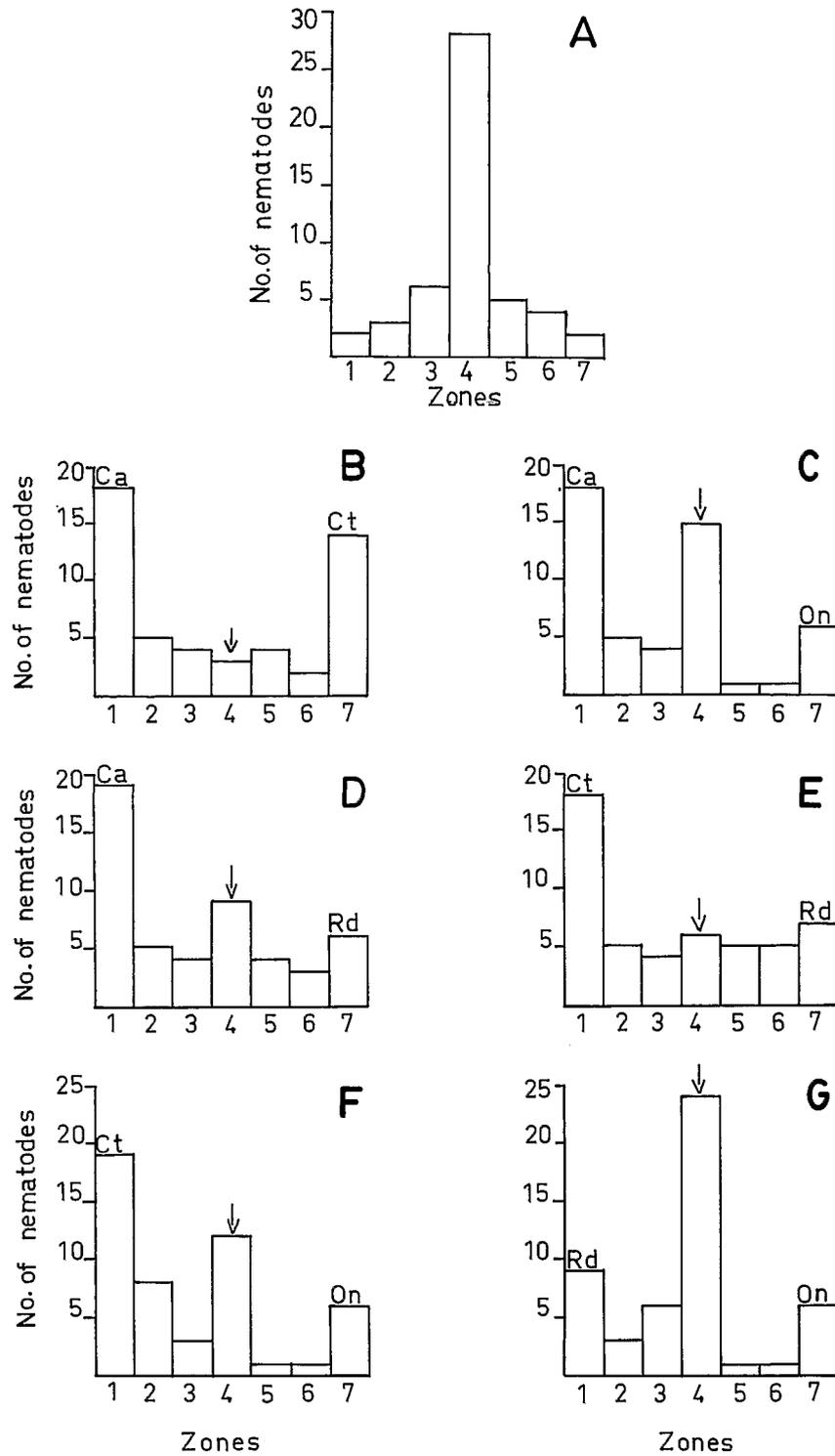


Fig. 5. Attraction of adult *H. oryzae* towards plant roots in combinations. A : without roots; Ca : cabbage; Ct : carrot; Rd : radish; On : onion (Arrows indicate point of introduction of nematodes).

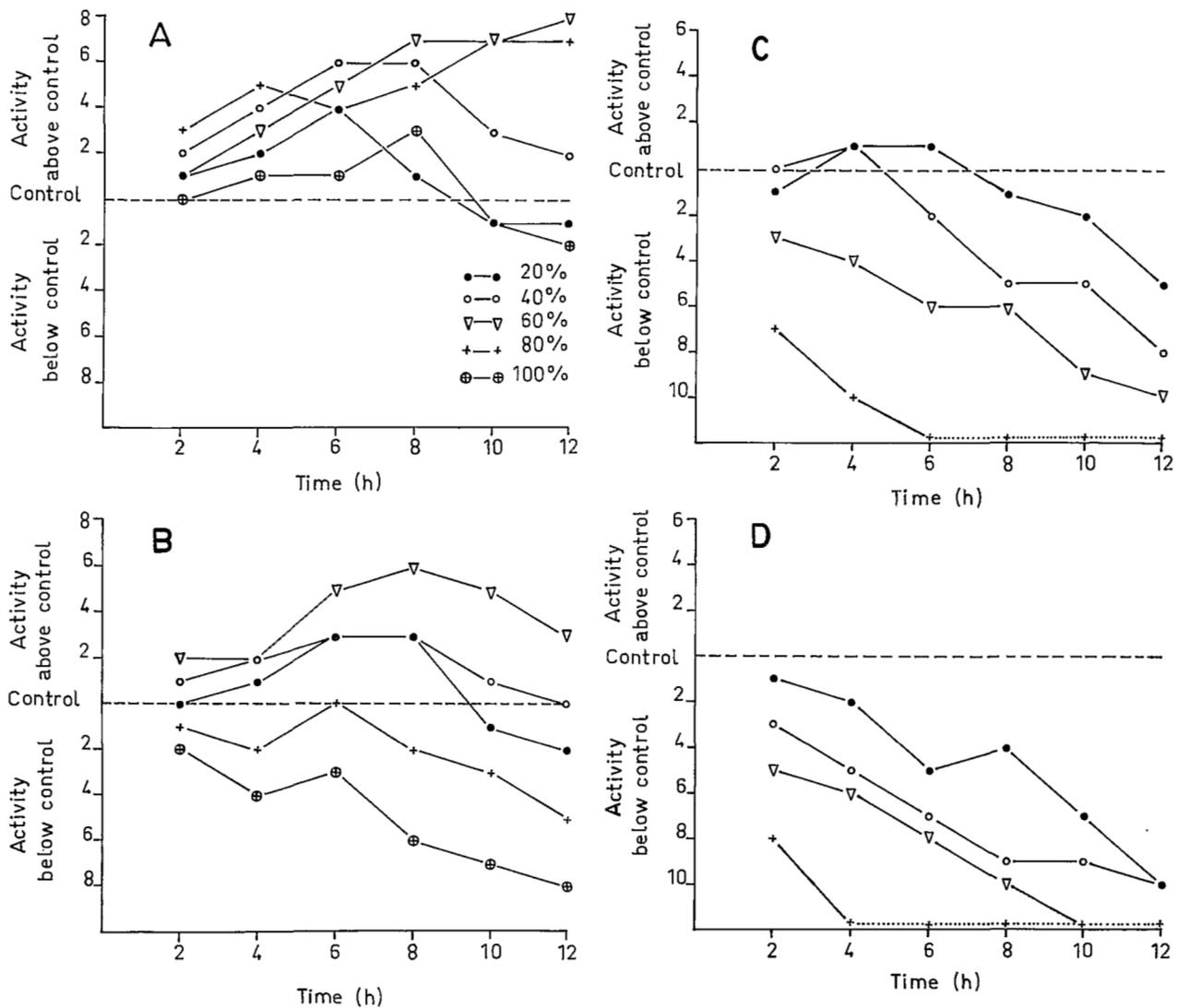


Fig. 6. Activity of adult *H. oryzae* in different concentrations of plant root homogenates. A : cabbage; B : carrot; C : radish; D : onion.

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