from all other described species except *carpocapsae*. From this latter species, *N. rara* can be distinguished by a smaller average distance from the head to the pharynx base (102 (89-120) µm in *N. rara vs* 120 (103-190) µm in *N. carpocapsae*) and differences in ratio D (distance from the head to the excretory pore divided by distance from head to base of pharynx) which range from 0.30-0.39 in *N. rara* and 0.23-0.28 in *N. carpocapsae* (in infective juveniles).

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IN VITRO RESPONSE OF *CRICONEMELLA XENOPLAX* TO NONFUMIGANT NEMATICIDES

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Greenhouse tests have been conducted with populations of *Criconemella xenoplax* (Raski) Luc & Raski, stressed monthly with low doses of nonfumigant nematicides (NFN) (Yamashita, Viglierchio & Kuo, 1988). All stressed populations appeared to respond differently to one or more NFN treatments than did a wild population with no previous history of NFN stressing.

An *in vitro* bioassay was used previously to characterize various populations of *Xiphinema index* (Yamashita & Viglierchio, 1987 *a*), *Meloidogyne incognita* and *Pratylenchus vulnus* (Yamashita & Viglierchio, 1986 *b*) and *Heterodera Schachtii* (Viglierchio & Brown, 1989) for demonstration of consonant behaviors. A 24-hour exposure of nematodes to relatively high concentrations of NFN served to express other characteristics not evident in results from field and greenhouse trials. Differences between stressed and wild populations were often consistent with those expressed under greenhouse testing.

Subsequent studies implicated at least two general modes of increased tolerance to NFN (Yamashita & Viglierchio, 1987 *b, c*). One involved apparent genetic characteristics unique to specific populations, suggesting true resistance. A second mode appeared in all populations following a pulse with low NFN doses, suggesting a transient phenomenon much like enzyme production (Yamashita & Viglierchio, 1978 *b*). The following studies seek additional characterization of wild and various NFN-stressed populations of *C. xenoplax* for comparison to other nematode species and an improved understanding of NFN activity.

Materials and methods

Populations of *C. xenoplax* utilized in these experiments included the following : A wild population (W-P, with no previous history of nematicide treatments) and four nematicide-stressed populations with over a year history of continuous monthly subnematicidal stressing. One population was stressed with carbofuran (C-S-P), a second with oxamyl (Ox-S-P), a third with phenamiphos (P-S-P) and a fourth with aldicarb (A-S-P). The stressing procedures were as previously described (Yamashita, Viglierchio & Kuo, 1988).

The techniques utilized for the *in vitro* testing were essentially those previously described (Yamashita & Viglierchio, 1986 *b*, 1987 *a*; Viglierchio & Brown, 1988). The concentrations of nematicides employed are indicated in Table 1.

Experience revealed a tendency for slight variations between different stock culture pots within a population. Therefore the experiment was repeated three times, each time with nematodes from a different stock culture pot of the population being evaluated. Because of slight variations of nematode numbers in the aliquant, data were evaluated following a logit transformation [ln (number of active plus 0.5 divided by the number of inactive plus 0.5)]. Mean column comparisons were conducted using a Duncan's multiple range test with an upper significance level of 5 %.

Results

The observed touch responses are summarized in Tab. 1. The stressed population controls were significantly more responsive than W-P to touch stimulus. The A-S-P was the most responsive. Subjected to a 1.0 mM carbofuran treatment, the C-S-P was significantly more responsive in the bioassay than P-S-P and A-S-P which in turn were significantly more responsive than Ox-S-P and W-P. After an 0.5 mM oxamyl treatment, the C-S-P

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Table 1

In vitro tests with various populations of *Criconemella xenoplax*

	Nematicide Treatment				
Population	*Control*	*Carbofuran*	*Oxamyl*	*Phenamiphos*	*Aldicarb*
Wild	66.1 a	10.6 A	24.1 (1)	36.6 I	42.4 x
Carbofuran	76.1 b	39.7 C	71.4 (3)	78.5 II	84.2 y
Oxamyl	79.5 bc	19.3 A	38.7 (2)	83.3 II	87.9 y
Phenamiphos	73.9 b	24.1 B	34.4 (2)	84.9 III	95.1 z
Aldicarb	82.9 c	31.2 B	33.0 (1, 2)	74.1 II	87.3 y

Numbers represent the percentage of active nematodes following 24 hours exposure to tap water, 1.0 mM carbofuran, 0.5 mM oxamyl, 0.4 mM phenamiphos and 0.4 mM aldicarb. Comparisons should be made down each nematicide treatment column. Percentages not followed by a common designation are different at a significance level of 5 % or less.

was significantly more responsive than Ox-S-P and P-S-P which in turn were significantly more responsive than W-P. The A-S-P ability to respond was not different from W-P or ox-S-P and P-S-P. All stressed populations treated with 0.4 mM phenamiphos or aldicarb were more responsive to touch than W-P, and P-S-P was more responsive than all other treatments.

Protective action was evident in all but two stressed populations. All stressed populations that went untreated (water control) exhibited higher responsiveness to touch with respect to wildtype. Moreover, it appeared that there was higher responsiveness of P-S-P and Ox-S-P over the respective controls to both 0.4 mM phenamiphos and 0.4 mM aldicarb with a similar reaction of C-S-P to 0.4 mM aldicarb.

Although the generally low responsiveness of the carbofuran treatment in comparison to other NFN may be a function of a higher concentration utlized, this observation was inconsistent with those observations for *X. index* (Yamashita & Viglierchio, 1987), *M. incognita* and *P. vulnus* (Yamashita & Viglierchio, 1986 *b*) and *H. schachtii* (Viglierchio & Brown, 1989).

These *in vitro* results were generally inconsistent with those obtained in the greenhouse trials (Yamashita, Viglierchio & Kuo, 1988). For W-P in the greenhouse test, all nematicide treatments clustered around control which coincided with the grand mean of all populations, treated or untreated; whereas, in the *in vitro* test the control was substantially greater than all treatments with the carbofuran (1.0 mM) being the lowest. For the C-S-P in greenhouse trials nematicidal phenamiphos (P_n) and nematicidal carbofuran (C_n) were near the overall population grand mean while all other population levels whether treated or untreated were higher. In the *in vitro* results only carbofuran (1.0 mM) was low and all other treatments were higher. For the Ox-S-P in greenhouse trials, the population levels of all nematicidal treatments and control were near the population level average; whereas, in the *in vitro* tests the carbofuran treatment (1.0 mM) was lowest, the oxamyl (0.5 mM) was next lowest and all others were very high. For the P-S-P in greenhouse trials, the nematicidal treatments, Ox_n, P_n, C_n and controls were below the population level overall average and nematicidal aldicarb (A_n) was somewhat above, while for the A-S-P all nematicidal treatments clustered around the overall average with controls somewhat above. In the *in vitro* test the P-S-P and the A-S-P provided low values for carbofuran and oxamyl treatments and very high values for all others. The possible factors implicated in the generation of the observations of *in vitro* tests have been discussed elsewhere (Viglierchio & Brown, 1988) while those implicated in the results of the greenhouse trials have also been previously discussed (Yamashita & Viglierchio, 1986 *a;* Yamashita, Viglierchio & Schmitt, 1986; Yamashita, Viglierchio & Kuo, 1988; Viglierchio, Brown & Kuo, 1989).

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SENSIBILITÉ DE TROIS VARIÉTÉS DE NIÉBÉ *(VIGNA UNGUICULATA)* AUX NÉMATODES DE LA ZONE SAHÉLIENNE DU SÉNÉGAL

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Un tri variétal mené sur des cultivars de niébé, *Vigna unguiculata* (L.) Walp, au Sénégal et au Nigeria vis-à-vis de trois races de *Meloidogyne incognita* et d'une race de *Meloidogyne javanica* a révélé que seul le cultivar TVU 857 du Nigeria est fortement résistant (Odihirin, 1981). Swanson et Van Gundy (1984) rapportent que ces deux espèces ont une plus faible reproduction sur le cultivar Californian Blackeye N° 5 que sur d'autres cultivars américains de niébé et que ce cultivar serait résistant à la race 4 de *M. incognita*.

L'extension de la culture du niébé a été préconisée dans le nord de la zone sahélienne du Sénégal. En effet, cette plante à cycle court (60 jours) permet d'assurer une certaine production vivrière en dépit du déficit pluviométrique que connaît cette région, déficit caractérisé par un raccourcissement de la durée des pluies. Se pose alors le problème de la sensibilité de cette plante aux nématodes présents dans les sols. En effet, dans cette zone, des augmentations importantes de rendement ont été obtenues par traitement nématicide sur arachide *(Arachis hypogea L.)* (Germani, Baujard & Luc, 1985).

Trois cultivars de niébé, choisis pour leur importance dans le bassin arachidier, ont été testés en serre : cv N 58-57 (port rampant; forte production en fanes et en gousses); cv N'Diambour (cultivar issu de cv N 58-57 × cv N 58-41; grosses graines); cv Mougne (cultivar issu de cv Pout × cv N 58-74; indifférence à la photopériode). Le sorgho, cv 51-69, est utilisé comme plante témoin.

Ces tests sont conduits sur un sol sableux préalablement stérilisé par la chaleur (120°, 30 min).

Les vases de végétation sont maintenus à température constante dans un bain-marie thermostaté à 30°, sauf pour *Scutellonema cavenessi* (35°).

Les élevages sont conduits sur des volumes de sol de 1 dm^3 pour *Meloidogyne incognita* (Kofoid & White, 1919) Chitwood, 1949 et *Meloidogyne javanica* (Treub, 1885) Chitwood, 1949 et de 250 cm^3 pour *Paratylenchus* sp., *Tylenchorhynchus sulcatus* de Guiran, 1967, *Pratylenchus sefaensis* Fortuner, 1973, *Helicotylenchus dihystera* (Cobb, 1893) Sher, 1961, *Criconemella curvata* (Raski, 1952) Luc & Raski, 1981, *Hoplolaimus pararobustus* (Schuurmans Stekhoven & Teunissen, 1938) Sher, 1963, *Heterodera gambiensis* Merny & Netscher, 1976 et *Scutellonema cavenessi* Sher, 1964. Chaque traitement comporte cinq répétitions sauf pour *Meloidogyne* spp. (dix répétitions) et *S. cavenessi* (sept répétitions).

Les graines de niébé des cultivars à tester sont mises en pré-germination 24 h en étuve à 30° et repiquées dans les vases de végétation à raison d'une graine par vase; l'inoculation des nématodes a lieu dix jours après. L'inoculum provient des élevages du laboratoire. La culture est maintenue pendant deux mois.

Les analyses nématologiques sont effectuées sur 250 cm^3 du sol par élutriation (Seinhorst, 1962) et sur la totalité du système racinaire par aspersion (Seinhorst, 1950). Les nématodes du sol sont dénombrés après être restés sept jours sur le tamis, ceux des racines après sept et quatorze jours d'aspersion.

Le tableau 1 donne les résultats des comptages. Les trois cultivars de niébé testés ne sont pas hôtes pour *H. gambiensis* et *Paratylenchus* sp., sont mauvais hôtes pour *P. sefaensis* et permettent le maintien des popula-

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