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Population dynamics of *Hirschmanniella mucronata* and *H. oryzae* on *Sesbania rostrata*, *Aeschynomene afraspera* and rice cv. IR 58 (1)

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Summary — Studies on the population dynamics of *Hirschmanniella oryzae* and *H. mucronata* on *Sesbania rostrata, Aeschynomene afraspera,* and rice cv. IR 58 were conducted under greenhouse and field conditions. The greenhouse experiment was conducted in pots with initial inocula of 500, 5000, and 10 000 nematodes per plant. Root and soil nematode populations were estimated at 15, 30, 45, 60, and 75 days after transplanting (DAT). Field experiments were conducted on two irrigated rice fields naturally infested with either *H. oryzae* or *H. mucronata.* Root and soil nematode populations were estimated at 0, 15, 30, 45, 60, 75, 90 and 120 days after transplanting (DAT). In rice, nematode populations in the roots gradually increased to a maximum at 30-45 DAT and then decreased until harvest. Simultaneously, the number of nematodes detected in soil progressively decreased until 30-45 DAT and then increased again. In *S. rostrata* and *A. afraspera,* the nematode root populations increased progressively from transplanting to 60 DAT under field conditions and 45 DAT under greenhouse conditions. During the same period the nematode soil populations decreased to less than 1/dm^3 of soil. Between 45-60 DAT and 90 DAT the nematode root population decreased to less than 1/g of root, whereas the nematode soil populations did not increase and remained at less than 1/dm^3 of soil. These results indicate that *S. rostrata* and *A. afraspera* can effectively control *H. oryzae* and *H. mucronata* populations in field and greenhouse conditions.

Résumé — *Dynamiques de populations de* Hirschmanniella oryzae *et* H. mucronata *sur* Sesbania rostrata, Aeschynomene afraspera *et riz cv. IR 58* — Les dynamiques de populations de *Hirschmanniella oryzae* et *H. mucronata* sur *Sesbania rostrata, Aeschynomene afraspera* et riz cv. IR 58 ont été étudiées en serre et au champ. L'expérience en serre a été conduite avec des inoculums initiaux de 500, 5000 et 10 000 nématodes par plante. Les populations de nématodes ont été estimées dans le sol et dans les racines 15, 30, 45, 60 et 75 jours après inoculation. Les expériences au champ ont été conduites sur deux rizières irriguées naturellement infestées l'une par *H. oryzae,* l'autre par *H. mucronata.* Les populations de nématodes ont été estimées dans le sol et dans les racines 0, 15, 30, 45, 60, 75, 90 et 120 jours après repiquage. Des résultats similaires ont été obtenus en serre et au champ. Sur riz, les populations de nématodes observées dans les racines ont augmenté à partir du repiquage pour atteindre un maximum 30 jours (en serre) et 45 jours (au champ) après le repiquage. Ensuite, ces populations ont décru jusqu'à la récolte. Simultanément, les nombres de nématodes détectés dans le sol ont diminué progressivement jusqu'à 30-45 jours après repiquage puis augmenté jusqu'à la récolte. Avec *S. rostrata* et *A. afraspera,* les populations de nématodes observées dans les racines se sont accrues progressivement jusqu'à 45 jours et 60 jours après le repiquage respectivement en serre et au champ. Dans le même temps, les populations observées dans le sol ont fortement diminué pour atteindre moins de un nématode par décimètre cube. Entre 45-60 jours après repiquage et la récolte, les populations de nématodes observées dans les racines ont diminué pour atteindre moins de un nématode par gramme de racine; dans le même intervalle de temps, les densités de population dans le sol sont restées inférieures à un nématode par décimètre cube. Ces résultats indiquent que *S. rostrata* et *A. afraspera* peuvent efficacement contrôler les populations d'*H. oryzae* et d'*H. mucronata* dans les conditions du champ aussi bien qu'en serre.

Key-words : *Hirschmanniella,* populations, *Sesbania, Aeschynomene,* rice.

Hirschmanniella oryzae (Van Breda de Haan, 1902) Luc & Goodey 1963 and *Hirschmanniella mucronata* (Das, 1960) Luc & Goodey, 1963, rice root nematodes, are present in high population densities in most irrigated rice fields throughout Asia (Sher, 1968; Sato & Kosyhyhara, 1970; Fortuner & Merny, 1979; Madamba *et al.,* 1981; Subramanian & Velayuthan, 1983; Ichinohe, 1988) and are known to cause severe damage to rice crops (Panda & Rao, 1971; Mathur & Prasad, 1972; Fortuner, 1977). Chemical control of nematodes in irrigated rice fields while effective, may have undesirable side effects such as persisting in grains (Visalakshi *et al.,*

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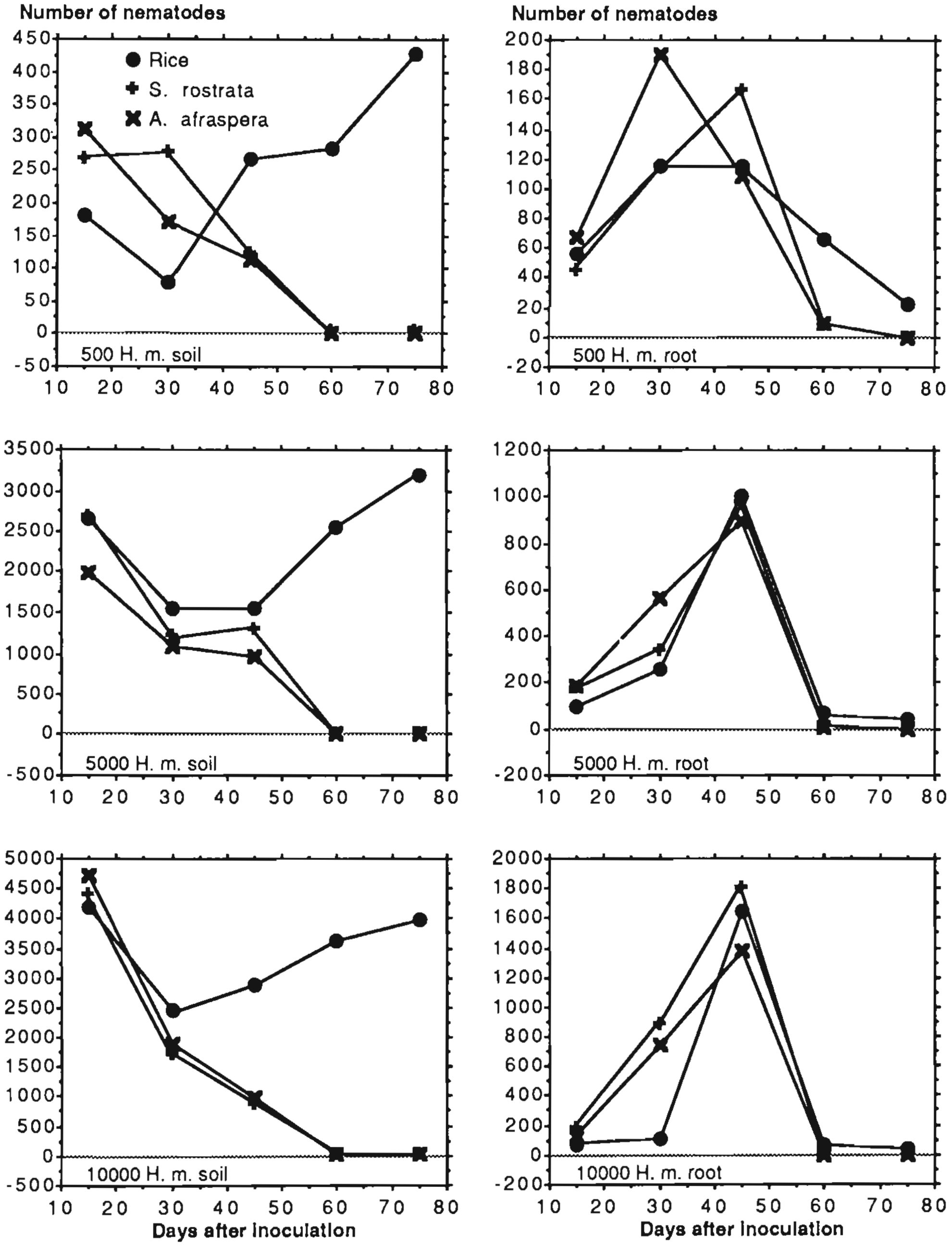

Fig. 1 : Average (3 replications) total numbers of *Hirschmanniella mucronata* observed in the soil and the root system of rice cv. IR 58, *Sesbania rostrata* and *Aeschynomene afraspera* plants inoculated with 500, 5000, and 10 000 nematodes and grown for 75 days in a greenhouse.

than those observed with *S. rostrata* and *A. afraspera* by Mann-Whitney test at the 5 % level.

FIELD EXPERIMENTS

Results observed were similar in the two rice fields naturally infested with *H. mucronata* and *H. oryzae.* These results are shown on Figure 3.

In the rice field plots, the average root nematode populations gradually increased until a maximum of approximately 35 nematodes/g of root was reached at 45 DAT and then decreased until harvest. Simultaneously, the average numbers of nematodes detected in

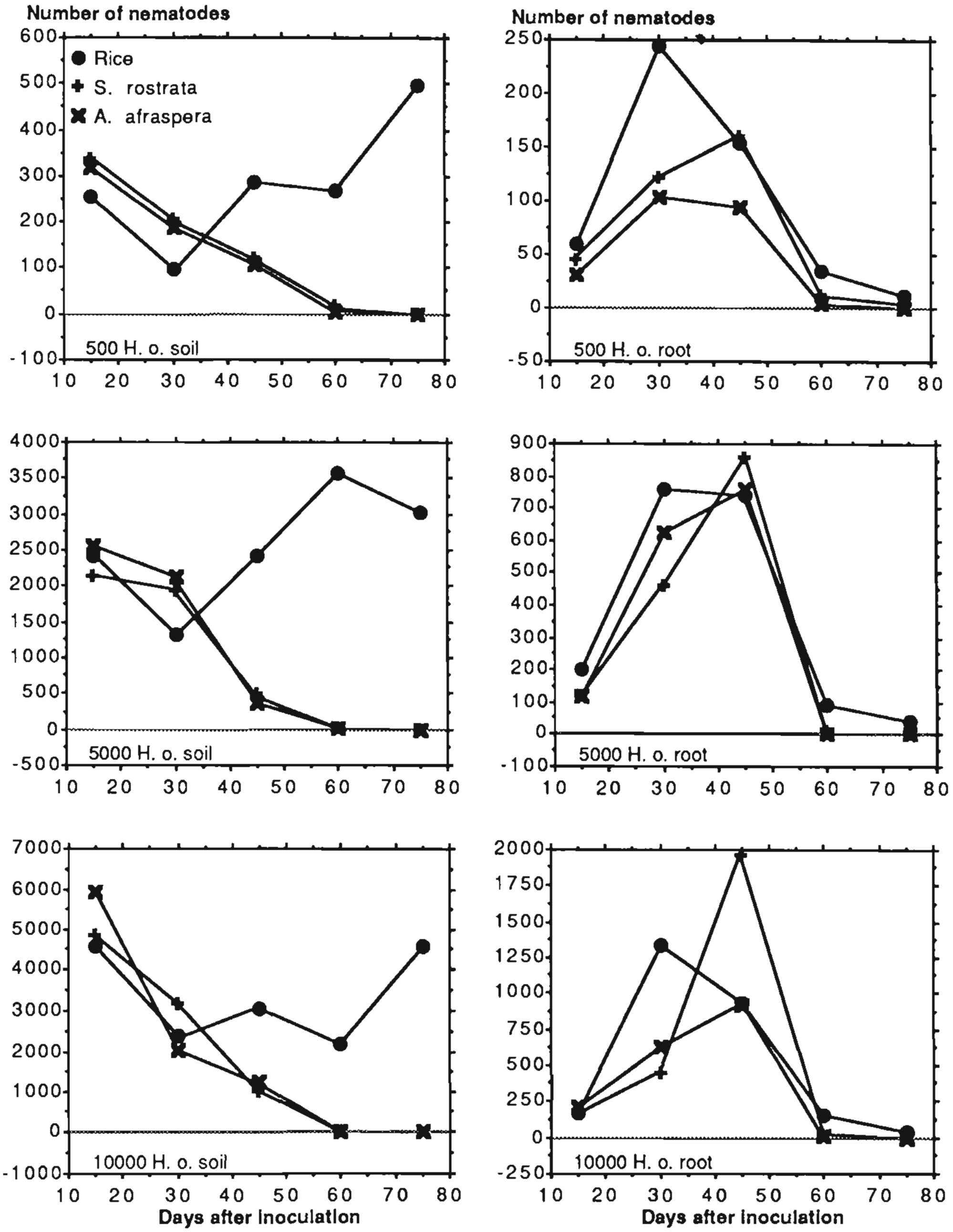

Fig. 2 : Average (3 replications) total numbers of *Hirschmanniella oryzae* observed in the soil and the root system of rice cv. IR 58, *Sesbania rostrata* and *Aeschynomene afraspera* plants inoculated with 500, 5000, and 10 000 nematodes and grown for 75 days in a greenhouse.

the soil progressively decreased until 45 DAT and then increased again to reach population densities approximately equal to the initial population densities.

In *S. rostrata* and *A. afraspera* field plots, the nematode root populations increased progressively from transplanting to 60 DAT when the average number of nematodes reached a maximum of 5 to 10/g of root. Between 60 DAT and 120 DAT the nematode root population decreased to less than 1/g of root. The nematode soil populations decreased constantly from transplanting to 120 DAT to reach undetectable levels at the end of the experiments. A two-way analysis of variance has shown that, at the 5 % level, in both fields : *i)* the average initial population of nematodes observed in the different treatments were not significantly different; *ii)* the factor block did not affect significantly the numbers of nematodes observed in the soil and the roots of the three crops; *iii)* the number of nematodes detected per g of root were significantly higher in rice than in the two legume crops at all sampling times; *iv)* the numbers of *H. oryzae* observed in the soil of the rice plots were significantly lower at 15, 30, and 45 DAT and significantly higher at 60, 75, and 90 DAT than those observed in plots cultivated with the legume crops; *v)* the numbers of *H. mucronata* observed in the soil of the rice plots were significantly lower at 45 DAT and significantly higher at 60, 75, and 90 DAT than those observed in plots cultivated with the legume crops.

Discussion

The results obtained on rice under greenhouse and field conditions confirm the observations that the maximum population present in the roots is reached between tillering and heading (Fortuner, 1976), and that the soil population is rebuilt at the end of the rice crop when the nematodes are leaving the roots (Merny, 1972). When initial inoculum of 5000 and 10 000 nematodes were used in the greenhouse experiment the average number of nematodes recovered from rice pots at 75 DAT was less than the initial inoculum. This indicates that a rice plant grown in a pot with only 500 cm^3 of soil can not sustain these high numbers of nematodes.

The results obtained with *S. rostrata* under greenhouse and field conditions confirmed the previous observation made in microplots (Germani *et al.*, 1983, Pariselle, 1987) and pot (Pariselle & Rinaudo, 1988)

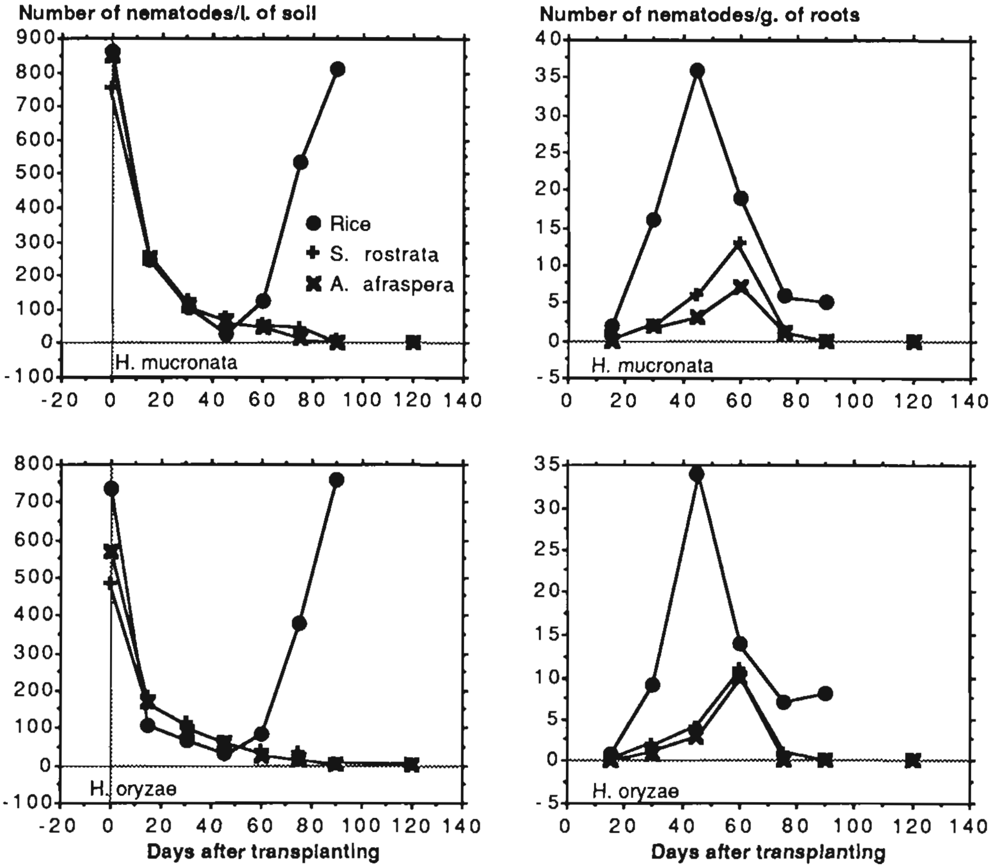

Fig. 3 : Average numbers of *Hirschmanniella mucronata* (7 replications) and *Hirschmanniella oryzae* (6 replications) observed, at 15 days intervals for 120 days, in the soil and the root system of rice cv. IR 58, *Sesbania rostrata* and *Aeschynomene afraspera* in two fields naturally infested.