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Effect of *Sesbania rostrata* on *Hirschmanniella oryzae* in Flooded Rice

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Abstract: Microplot experiments on flooded soil infested with *Hirschmanniella oryzae* were conducted to investigate the influence of the legum *Sesbania rostrata* as a rotation crop with rice, *Oryza sativa* L. cv. Moroberekan. To avoid a green manure effect from *S. rostrata,* all aerial parts were removed at harvest. The dry weight of paddy, culms and leaves, and number of culms of rice following *Sesbania* were 214%, 158%, and 121% greater, respectively, than those following rice. Ripening of the paddy occurred earlier if rice followed *Sesbania.* The beneficial effect of *Sesbania* may have been due to the trap-crop action of *Sesbania* against *H. oryzae. Key words:* trap crop, crop rotation.

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Crop rotation has recently received attention as a pest-management tactic to decrease damage to upland rice, *Oryza sativa* L., by *Rotylenchulus* spp. and *Meloidogyne* spp. (1,2,3), *Meloidogyne graminicola* (8,9), or *Pratylenchus indicus* (7). Comparable information concerning flooded rice attacked by *Hirschmanniella* species is not available.

Sesbania rostrata (Brem.), a legume capable of fixing nitrogen in flooded soils (5, 6), is a potential crop for rotation with rice. Its suitability as a green manure crop preceding rice has been demonstrated; grain and straw yields were doubled and the nitrogen content of the grain was increased about 50% (10,11). In preliminary glasshouse tests *S. rostrata* did not support reproduction of *Hirschmanniella oryzae* (van Breda de Haan, 1902) Luc & Goodey, 1964 or *H. spinicaudata* (Schuurmans Stekhoven, 1944) Luc & Goodey, 1964, the two nematode species prevalent in flooded rice fields in West Africa. We therefore conducted experiments to determine the influence of an intercrop of *S. rostrata* on the production of flooded rice infested by *H. oryzae.*

MATERIALS AND METHODS

Seventeen concrete microplots (1 × 1 × 1 m), closed at the base were filled with metham (Vapam® at 60 g a.i./m^2) treated rice-field soil to a depth of 80 cm. The soil was infested with *Hirschmanniella oryzae,* and two crops of rice were grown under constantly flooded conditions to establish a satisfactory initial population (P_i) level. One group of eight microplots had a P_i of 4,330 (nematodes/dm^3 soil); another group of nine microplots had a P_i of 3,580. Two rotations were tested: *Sesbania* followed by rice (eight microplots) and rice followed by rice (nine microplots). At the first planting, nine 2-month-old *Sesbania* seedlings were planted in each of the eight microplots; sixteen 2-week-old rice cv. Moroberekan seedlings were planted in each of the other nine microplots. All plants were harvested at the same time, and all the aerial parts of the plants were removed to avoid a green manure effect on the subsequent crop of rice. During the first cycle, 3 g of urea and 3 g of mineral fertilizer (N, P, K: 8-18-27) were added to each microplot.

The second crop of Moroberekan rice was planted 14 July in all the microplots by the same procedure as the first rice planting. The rice was harvested on 20 October and 9 and 25 November as the grain ripened. At the last harvest all aerial parts were harvested, dried, and weighed.

Nematodes were extracted from soil by elutriation (13) and from roots by a mistifier adapted from Seinhorst (12). Nitrogen content of soil was determinated by the Kjehldahl method using the indophenol blue colorimetric assay by a Technicon Automatic Analyzer.

RESULTS

Infection of *Sesbania* roots by *H. oryzae* occurred early to midseason and the nematode population in the soil decreased rapidly near the end of the growing season (Table 1). This suggests that *Sesbania* may act as a trap crop.

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Table 1. Population levels of *Hirschmanniella oryzae* at start of the experiment (Pi),* at midseason (Pm), and at harvest (Ph) of the first crop (rice or *Sesbania*) and at harvest for the second crop (rice after rice or rice after *Sesbania*).

Rotation	Number of *H. oryzae* per 1 dm^3 soil			100 g roots
	Pi	Pm	Ph	Ph
First crop				
Sesbania	4,330	5,040	1,630	60
Rice	3,580	25,600	3,740	15,300
Second crop				
Rice (after *Sesbania*)	...	...	3,880	12,560
Rice (after rice)	...	...	2,900	16,930

*Pi established by growing two crops of rice before initiating the experiment.

Regardless of the previous crop, numbers of nematodes in the soil and in roots at harvest of the second crop were not different ($P = 0.05$) (Table 1). However, the preceding crop did affect the dry weight of paddy and green parts and the number of culms of the second crop (Table 2). Rank correlation according to Spearman (4) between the different parameters indicated that paddy weight, number of culms, and weight of leaves and culms were inversely correlated with the number of nematodes in roots and soil of the preceding crop. Moreover, the cultivation of *Sesbania* before growing rice caused early ripening of the grains (Fig. 1). At the first harvest 90% of the paddy was ripe for rice following *Sesbania*, but only 45% for rice following rice.

There was no significant difference in the nitrogen content of the soil after *Sesbania* or the first crop of rice.

DISCUSSION

The beneficial effect of *Sesbania rostrata* on a subsequent crop of rice appears to be related to its depressive action on the nematode population because paddy yield and weight of green parts were related to the initial population, the potential for a green manure effect was eliminated by removal of all aerial parts of *Sesbania*, and the nitrogen contents of the soils after *Sesbania* and rice were not different.

Table 2. Dry weights of paddy and green parts, and number of culms of rice following a previous crop of rice or *Sesbania*.

Preceding crop	Dry weight (g) Paddy	Green parts	Number of culms
Rice	168.5	234.3	2.8
Sesbania	527.9	605	6.2
t	5.9	5.6	4.6
	$P < 0.001$	$P < 0.001$	$P < 0.001$

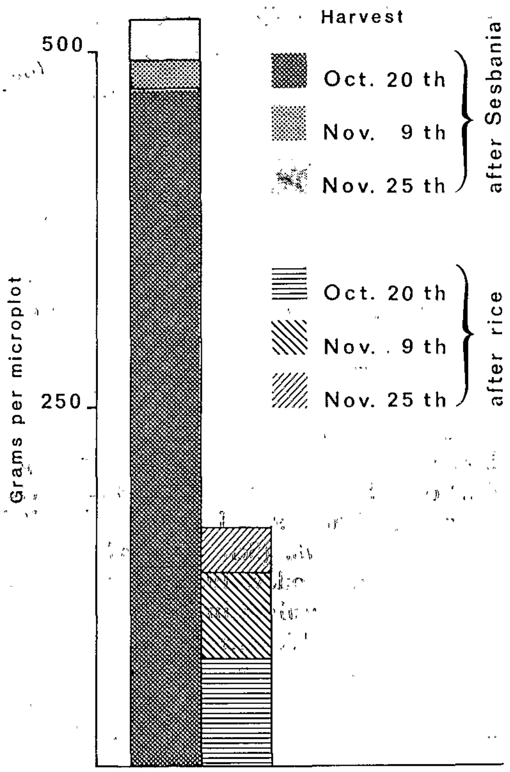

Fig. 1. Mean weight (grams per microplot) of rice paddy at three succeeding harvests following *Sesbania* and rice.

Soil populations of the nematode at harvest of the second crop were not different in the two series of microplots. This suggests that the level of nematode infestation in soil during the first weeks of the rice cultivation had a significant influence on the subsequent development of the plant. Differences between numbers of nematodes in the soil after the first crop of rice and *Sesbania* were not great, but numbers of nematodes were greater (P = 0.05) in roots of rice then in roots of *Sesbania*. These results indicate that roots of rice could serve as a reservoir for nematodes that attack the subsequent crop.

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