HOST STATUS OF YAM COMPONENT CROPS TO *Scutellonema bradys* (Steiner and LeHew) Andrassy

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ABSTRACT
This study was carried out to assess the contribution of yam intercrops in the continued infestation of yam tubers with S. bradys. Seven main intercrops of yam and two cowpea varieties were used for the study. The cowpea varieties were used as a check because yams were dormant at the time of the study. S. bradys-infested yam tubers bought from the Kumasi Central Market were used as inoculum. The modified Baermann funnel method for nematode extraction was used. Based on the number of juveniles and adults of S. bradys recovered from the root tissues, cowpea, tomato, okra, cassava and sorghum were found to be alternative hosts of the nematode. However, cowpea and tomato were very good alternative hosts. Maize, melon and chilli pepper were non-hosts. Nematode multiplication in roots showed that S. bradys could survive endoparasitically in the roots of other crops. The effect of nematode numbers on the state of the roots of the intercrops screened revealed that generally, necrosis increased with increasing number of the nematode. Following this study, it is recommended that maize, melon and chilli pepper could be intercropped with yam.

Keywords: *Yam, Scutellonema bradys, nematode, intercrops, host.*

INTRODUCTION

The yam nematode, *S. bradys* is the cause of decay of yam tubers known as dry rot disease, and is the most important of yam nematodes in Ghana (Plowright and Kwoseh, 1998; Bridge *et al*., 2005). Losses from dry rot disease have been estimated to be about 21% in the forest transition zone and 30% in the Guinea-Savannah zone of Ghana (Kwoseh *et al*., 2005). The nematode problem has been aggravated by intensive cultivation (African farming and Food processing, 1993), shortened fallow periods ranging between one and three years (Plowright and Kwoseh, 1998) and sub-optimal storage conditions (Kwoseh *et al*., 2005).

Yam nematodes are difficult to control and their elimination by chemicals is not feasible. Chemical control of *S. bradys* has had some success, but information on the economics of this means of control is lacking for large scale use (Ayala and

Acosta, 1971). There is no firm evidence of complete resistance to *S. bradys* in yams, and all the main yam varieties that have been examined in West Africa were susceptible to infection by *S. bradys* (Adesiyan and Odihirin, 1977; Bridge, 1982; Kwoseh, 2000). Keeping land free of all host plants is a suggested means of controlling *S. bradys*, but this is not always economical or practical (Decker *et al*., 1967). As demand for land increases through demographic pressures, fallow periods reduce and cropping systems change and using good crop hosts in rotations or as intercrops help increase the nematode population in the soil (Adesiyan, 1976).

Hot water treatment can reduce or eliminate *S. bradys* from tubers. While farmers appreciate the benefits of the treatment, the cost and access to resources, labour requirements and the expense of heating equipment, and the difficulties of maintaining constant temperatures are the main prohibitive factors against its widespread use by farmers (Speijer, 1996; Meerman and Speijer, 2001). There are some indications that hot water treatment of tubers can adversely affect sprouting ability of seed pieces cut into minisetts (Coyne, Unpublished). The use of biological agents to control nematodes has also not been practically achieved (Bridge *et al*., 2005).

Most of the crop mixtures in the yam cropping system have been reported by Bridge (1973), Adesiyan (1976) and Bridge (1978) as hosts of *S. bradys* in Nigeria. The high infestation of yam tubers by the yam nematode may be due to the build up of nematodes in the soil and as a result cause more damage. Also, the component crops may serve as alternative host crops of *S. bradys*, therefore increasing disease incidence.

The host range of *S. bradys* has not been adequately investigated, especially in Ghana and it is possible there are a few other hosts for the nematode apart from yam. The rotation or the intercropping of suitable crops may effectively reduce nematode population. This is complicated by the intercropping practices employed by many farmers who often have three to four crops growing with yam in the same season (Bridge, 1972; Kwoseh *et al*., 2005). A survey by Kwoseh *et al*. (2005) revealed that the dominant component crops of yam cropping system in Ghana are cassava, chilli pepper, maize, sorghum, melon, okra, millet, tomato and pigeon pea. However, it is reported that cowpea supports very high root populations of *S. bradys* (Adesiyan, 1976). The study therefore assessed the role played by each of the named yam intercrops in the dissemination of *S. bradys* in yam cropping system.

MATERIALS AND METHODS

Soil sterilization

The experiment was conducted at the planthouse of the Faculty of Agriculture, KNUST, Kumasi. River sand soil mix in the ratio of 1:3 was sterilized using the moist-steam sterilization method (Kwoseh *et al*., 2000). Each pot of one litre size was filled with 850ml of the sterilized river sand-soil mix.

Planting and thinning of seedlings

The intercrops used in the study were maize (Obaatanpa), melon, chilli pepper, sorghum (Mankaraga), okra, cassava (Debo) and tomato (power). Two cowpea varieties (Adom and Asetenapa) were used as control and this was because at the time of the experiment, yam tubers were dormant. According to Adesiyan (1976), cowpea is a good alternative host of *S. bradys*.

Three seeds of each intercrop except cassava were planted in separate pots. The cassava cuttings of 22cm each were planted one per pot. The pots were arranged in a complete randomized design (CRD) with four replications. Four pots were used for each intercrop. The pots planted with the intercrops were randomized and placed on a bench in the planthouse. Routine watering was done when necessary with equal volumes of water. Three weeks after sowing, thinning of the seedlings was carried out leaving only one seedling per pot.

Source of inoculum and extraction of nematodes

Yam tubers showing symptoms of dry rot bought from the Kumasi Central market were used as source of inoculum. The modified Baermann funnel method (Whitehead and Hemming, 1965) was used to extract the nematodes. This set-up consisted of plastic baskets, shallow trays and double-ply tissue paper. The yam tubers were peeled and chopped. Each plastic basket, lined with two-ply tissue paper was put in a shallow tray separately. Ten grammes of chopped root tissues was spread carefully and evenly over the tissue paper. Water was carefully and slowly poured down into each tray until the tissue paper was moist. The set-up was left undisturbed in the laboratory under ambient conditions for 48h. After this period, the baskets were then carefully lifted and the water allowed to drain into the shallow trays. The nematode-water suspensions were poured into separate beakers. The shallow trays were rinsed of any nematodes and added to the collected suspensions. The suspension was left for 24h to settle. The supernatant of each suspension was poured off and the concentrated nematode suspension bulked in a beaker.

Counting of extracted nematodes

The *S. bradys*-water suspension for each intercrop was standardized to an equal volume of 40ml. The nematode suspension was stirred by blowing air through it using a pipette for homogeneity and 1ml aliquot pipetted onto a counting dish mounted on a stereo microscope and the number of nematodes counted. Two counts were made and the mean counts were then calculated. The total number of nematodes in the suspension was also calculated.

Inoculation of plants

Eight weeks after planting, inoculation was done with 800 *S. bradys* juveniles and adults per pot. Four holes of about 2cm from each stem were made in the soil and in each pot and the inoculum dispensed into them with the aid of a pipette.

Harvesting of plants

Harvesting was done 16 weeks after planting. The plants were carefully uprooted from each pot, washed free of soil and dubbed dry using tissue paper. The roots were examined for per cent necrosis. The washed roots of each intercrop were chopped and 5g of each root used for nematode extraction as described above and the number of nematodes counted.

Reproductive Factor (RF)

This indicates the reproductive rates of *S. bradys* in the roots of the intercrops. It is calculated as follows:

$$\text{RF} = \frac{\text{Final total no. of S. bradys/5g roots (Pf)}}{\text{Initial no. of S. bradys used for inoculatio n (Pi)}}$$

If the value of RF > 1, it means there was reproduction in the roots. If RF < 1, then, there was no reproduction in the roots.

Data analyses

The Genstat statistical package was used for analysing the data. The square root transformation of $\sqrt{(x+1)}$ was used to transform the nematode counts, where x is the mean total of number of *S. bradys*. Lsd (P = 0.05) was used to compare mean differences and correlation (r) to check the relationship between per cent necrosis and the mean number of *S. bradys* in roots.

RESULTS AND DISCUSSION

The intercrops differed in their rate of infestation to *S. bradys* in the pot experiment. No significant differences (P=0.05) were observed in the nematode counts recorded on maize, melon and chilli pepper (Table 1). However, Adom, Asetenapa, sorghum, cassava, okra and tomato differed significantly (P=0.05) (Table 1). Adom recorded the largest transformed nematode count of 58.7 with maize, melon and chilli pepper recording the least count of 1.0 each (Table 1). There was no significant difference between (P=0.05) Adom and tomato, both of which recorded very large numbers of *S. bradys*. From the study, it was found that

Table 1: Total number of nematodes and root health status of intercrops eight weeks after inoculation

Yam intercrops	%Healthy roots	%Necrotic roots	Mean nematode counts/5g roots (*Transformed)
Maize	82.5bc	17.5 a	1.0 a
Cowpea (Adom)	15.5 a	84.5 b	58.7 bc
Melon	50.0 b	50.0 b	1.0 a
Sorghum (mankaraga)	3.0 a	97.0 bc	12.3 ab
Cowpea (Asetenapa)	8.8 a	91.2 bc	24.8 b
Okra	19.5 a	80.5 bc	22.0 b
Tomato	2.7 a	97.3 bc	55.2 bc
Chilli pepper	78.2bc	21.8 a	1.0 a
Cassava	70.7bc	29.3 a	10.3 ab
LSD (5%)	18.9	19.4	18.3
CV (%)	35.9	21.3	74.8

Figures followed by the same letter(s) are not significantly different (P = 0.05) according to Duncan's Multiple Range Test. * = $\sqrt{(x + 1)}$

Table 2: Reproductive rates of *S. bradys* in the roots of the intercrops

Yam intercrops	Total No. of S. brady/5g root tissue (Pf)	[a]Reproductive Factors (RF)
Cowpea (Adom)	3440.0	4.3
Cowpea (Asetenapa)	640.0	0.8
Maize	0.0	0.0
Melon	0.0	0.0
Okra	2200.0	2.8
Tomato	3290.0	4.1
Chilli pepper	0.0	0.0
Cassava	187.0	0.2
Sorghum	200.0	0.3

[a]RF = Pf/Pi, where Pf is the total number of S. bradys/5g of root tissue and Pi is the initial population of S. bradys = 800. RF>1 means reproduction, RF<1 means no reproduction.
** = Control*

there are other hosts of *S. bradys* apart from yam namely cowpea, tomato, okra, sorghum and cassava. This gives indication that some of the main yam intercrops can be associated with the survival of *S. bradys* in yam fields. The intercrops mentioned-above were among those reported by Adesiyan (1976), Kermarrec *et al*. (1981) and Missah and Peters (2001) as hosts of *S. bradys*.

Maize was found to be a non-host of *S. bradys*. The nematode did not survive in the roots of maize and therefore no nematodes were recovered from the roots of maize eight weeks after inoculation. This means that all the juveniles and adults of *S. bradys* that were put in the maize pots might have died and therefore could not multiply. This is in line with the study by Bhatti and Walia

(1972) who reported that the important nematodes of maize are the corn cyst nematode, cereal cyst nematode, lesion nematode and root knot nematode all of which cause economic injury to the crop.

S. bradys did not reproduce in the roots of melon, and so no nematodes were recovered from them after extraction. The failure of the nematode to survive in the roots of melon is contrary to the observation by Kermarrec *et al*. (1981) that melon could increase soil populations of *S. bradys*. This observation may be due to varietal differences.

Chilli pepper did not support *S. bradys* multiplication in its root tissue. *S. bradys* could not survive in the roots of chilli pepper and hence a reproductive factor of 0 was recorded (Table 2). This observation agrees with that of Johnson and Burton (1973) that there is little information on *S. bradys* infestation on chilli pepper.

Cassava supported the survival of *S. bradys* (Table 1), but there was no reproduction (Table 2). Missah and Peters (2001) observed *S. bradys* in root and tuber crops such as cassava, cocoyam and potato but none appeared to be a good host. The number of nematodes recovered from the roots of sorghum did not differ significantly (P=0.05) from those of cassava roots (Table 1). Therefore, sorghum is a poor host of *S. bradys*. ICRISAT (1987) reported that *S. bradys* was barely found to limit yield in sorghum, but may become a problem if a field is planted continuously with sorghum for several years.

S. bradys survived and reproduced 2.8 times endoparasitically in the roots of okra (Tables 1 and 2). This suggests that *S. bradys* population could increase with time and therefore okra should notn be used in yam cropping system. Tomato supported very large number of *S. bradys* and this differed significantly (P=0.05) from the other intercrops except the two cowpea varieties and okra (Table 1.). This observation agrees with that of Adesiyan (1976) who reported that *S. bradys* survived endoparasitically in the roots of okra and tomato.

The largest number of nematodes was recovered in the roots of (Adom) (Table 2). The nematodes colonized the root tissues of the plant, survived there and multiplied at a very fast rate (Table 2). Adesiyan (1976) conducted a study of 30 crop plants and weeds as possible host of *S. bradys* and found that cowpea and benniseed were good alternative hosts of *S. bradys* in Nigeria.

The number of *S. bradys* extracted from the intercrops roots depended on the state of the roots. Generally, intercrops with high root necrosis supported large populations of *S. bradys* (Tables 1 and 2). A high positive correlation (r = 0.7) was observed between per cent necrotic roots and the number of nematodes in the roots.

The roots of maize, chilli pepper and cassava were healthy and this suggests that the absence of *S. bradys* reduced the necrosis of the roots. The moderately necrotic roots of melon with no nematode infestation could be attributed in part to ageing of the roots.

CONCLUSION

The study showed that *S. bradys* could survive endoparasitically in the roots of most of the yam intercrops. Juveniles and adults of *S. bradys* recovered from the root tissues indicated that cowpea, tomato, okra, cassava and sorghum are alternative hosts of *S. bradys*. However, cowpea and tomato are very good alternative hosts. Maize, melon and chilli pepper are non-hosts of the nematode. The three non-host crops of *S. bradys* should be intercropped or used in rotation with yam. This is likely to reduce field infestation of yam with *S. bradys*.

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