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*Full Length Research Paper*

# Evaluation of fallow and cover crops for nematode suppression in three agroecologies of south western Nigeria

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**A study was conducted in three agroecological zones of south-western Nigeria to evaluate the effect of siam weed (*Chromolaena odorata*) and mucuna (*Mucuna utilis*) cover/fallow crops on plant-parasitic nematode population. The natural bush regrowth was used as control. Plant-parasitic nematodes were identified and counted during the fallow periods. Eleven genera of nematodes were identified and three (*Meloidogyne*, *Pratylenchus*, and *Helicotylenchus*) species were predominant across the trial locations. Other important genera present were *Scutellonema*, *Tylenchorhynchus* and *Rotylenchus* species. Nematode population densities of pre-crop were lowest in Alagba soil (Rhodic lixisols) at Ikenne in the wet forest zone of Nigeria. The populations in Iwo soil (Rhodic haplustalf) at Ibadan, a dry forest zone was lower than in the Temidire soil (Plinthic luvisol) at Ilora in the derived savannah of south-western Nigeria. There was significant suppression of nematode population densities under the different crops as the fallow period increased. The population reduction in the different locations depended on the nematode species and the cover crops. The natural bush re- growth had the least effect on the nematode suppression at the end of the fallow period. On the average, siam weed fallow reduced nematode population densities by 67-79%, mucuna by 64-72% and the natural bush by 30-49% across the trial locations. For effective nematode suppression with fallow cropping, proper determination of the principal nematode species predominant in an environment is essential.**

**Key words:** Cover crop, fallow crop, nematode population, nematode species, nematode suppression, soil type.

## INTRODUCTION

Cropping systems involve yearly sequences and special arrangements of crops, or fallow on a given area, and affect the types and numbers of nematodes in a field (Taylor, 1971). Thus, cropping systems vary in creating conditions favourable or detrimental to specific nematode communities in the soil. While crops like soybean, peanut and okra may be susceptible to root-knot nematodes, a number of other crops (sorghum, corn, sudan grass and horsebean) may suppress some root-knot nematode species (Rodriguez- Kabana et al., 1987, 1992; McSorley and Gallaher, 1991; Weaver et al., 1993). The beneficial effect of mucuna on soil fertility improvement and nematode suppression was highlighted in the monograph authored by Carsky et al. (1998).

In crop rotation studies, Rodriguez-Kabana et al. (1992) reported that velvet bean (*Mucuna deeringianna*) was not a host to *Meloidogyne* spp. and therefore could be used to manage root-knot problems in several arable crops. Also, the suppressing effect of *M. deeringianna* on *Meloidogyne* spp. in rotation with vegetable and other crops has been well documented (McSorley et al., 1994; Gonzaga and Ferraz, 1994; McSorley and Dickson, 1995).

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**Table 1.** Some physical and chemical characteristics of the soils at pre-planting period.

| Soil properties | Ilora | Ibadan | Ikenne |
|---|---|---|---|
| pH | 6.0 | 6.1 | 6.2 |
| Sand (%) | 80 | 84 | 78 |
| Silt (%) | 10 | 10 | 11 |
| Clay (%) | 10 | 6 | 9 |
| Organic carbon (g $kg^{-1}$) | 5.3 | 6.4 | 6.2 |
| Ca (Cmol $kg^{-1}$) | 1.05 | 2.05 | 1.65 |
| Mg (Cmol $kg^{-1}$) | 0.68 | 1.23 | 0.92 |
| K (Cmol $kg^{-1}$) | 0.23 | 0.24 | 0.24 |
| Na (Cmol $kg^{-1}$) | 0.19 | 0.12 | 0.12 |
| $H^+$ (Cmol $kg^{-1}$) | 0.11 | 0.09 | - |
| ECEC (Cmol $kg^{-1}$) | 2.25 | 3.63 | 3.14 |
| Total N (mg/kg) | 0.50 | 0.50 | 0.70 |
| Avail. P, (mg $kg^{-1}$) | 5.00 | 6.20 | 5.40 |

ECEC: Effective Cation Exchange Capacity.

Roots of some plants contain chemicals that are toxic to some plant-parasitic nematodes (Yadav, 1970; Orr and Morey, 1974; Alan et al., 1975; Egunjobi and Afolami, 1976). Hackney and Dickerson (1979) showed that the root and soil population densities of *Meloidogyne incognita* were significantly lower in plantings of marigold, castor bean and cherry than that of tomato or in the surrounding soil. Amosu (1981) reported that root extract of siam weed is more effective in inhibiting the hatching of *M. incognita* eggs than in causing the death of juveniles after they hatched. In another study, Salawu (1988) reported significant reduction of root-knot nematode using neem extract.

Siam weed, *Chromolaena odorata*, a perennial shrub and cover crop is regarded an exotic weed plant in many countries (McFadyan, 1999; Scott et al., 1998; Kluge and Cadwell, 1992; Morris, 1991; Akinlosotu et al., 1990). However, reports from work of Apori et al. (2000) showed that the plant has some qualities that could be useful as source of organic matter in the soil. Also, Baruah and Sarma (1996) suggested that the crop could be used as mulch. Little or no information is available on the host status of siam weed to plant-parasitic nematodes. This study was aimed at evaluating different fallow periods with siam weed and mucuna for nematode suppression in the three soil types in three agro ecological zones of Nigeria.

## MATERIALS AND METHODS

Field trials were conducted to investigate the effects of fallow/cover crops on plant-parasitic nematode populations in the soil at Ilora in the derived savannah, Ibadan in the dry rainforest and Ikenne in the wet rainforest of south-western Nigeria. The soils at Ilora site was Temidire series classified as Plinthic luvisol, Rhodic haplustalf at Ibadan and as Rhodic lixisol at Ikenne. The sites formerly under maize/cassava cultivation for three years were cleared and planted to maize before trial establishment. The physical and chemical characteristics of the soil at the trial locations are shown in Table 1. The soils were sandy loam at Ilora and Ikenne, and loamy sand at Ibadan.

Mucuna (*Mucuna utilis*) and siam weed (*Chromolaena odorata*) were planted as cover/fallow crops. Natural bush regrowth was used as control. Mucuna seeds were obtained from the International Institute for Tropical Agriculture (IITA), Ibadan, Nigeria. Siam weed seeds were collected from naturally growing plants. However, the viability of siam weed seeds was low and full establishment of the fallow was ensured by transplanting the seedlings. After establishment, siam weed plot was maintained without additional efforts. To ensure proper establishment, replanting of mucuna was done annually using zero tillage operations. The experiment lasted three years.

Treatments were arranged in a plot area of 5 m x 3 m and replicated 4 times using a randomized complete block design. A space of 1.75 m was allowed between treatment plots and 2.5 m was spaced between blocks to minimize treatment interference. Due to the spreading nature of mucuna, vine growth was curtailed manually while borders and alleys were kept clean by regular weeding.

Soil samples were taken from each plot before planting, and at 12, 18, 24 and 30 months afterwards. At each sampling period, thirty-five soil-core samples were taken from each treatment plot at a depth of 20 cm, and thoroughly mixed to form one composite sample. Samples were sieved and placed in sealed plastic bags where they were stored at $10^{o}C$ for 24 h. Sub-samples (200 $cm^3$) were extracted by centrifugation, processed by using pie-pan method as described by Dunn (1970) and afterward analysed for nematode identification and population counts. Identification to generic level was done using the simplified nematode key of Mai and Lyon (1975). Data were subjected to analysis of variance and means separations using Duncan Multiple Range Test (SAS, 1985).

## RESULTS

The soils at the experimental sites varied both in physical and chemical characteristics (Table 1). At test initiation, populations of plant parasitic-nematodes varied with

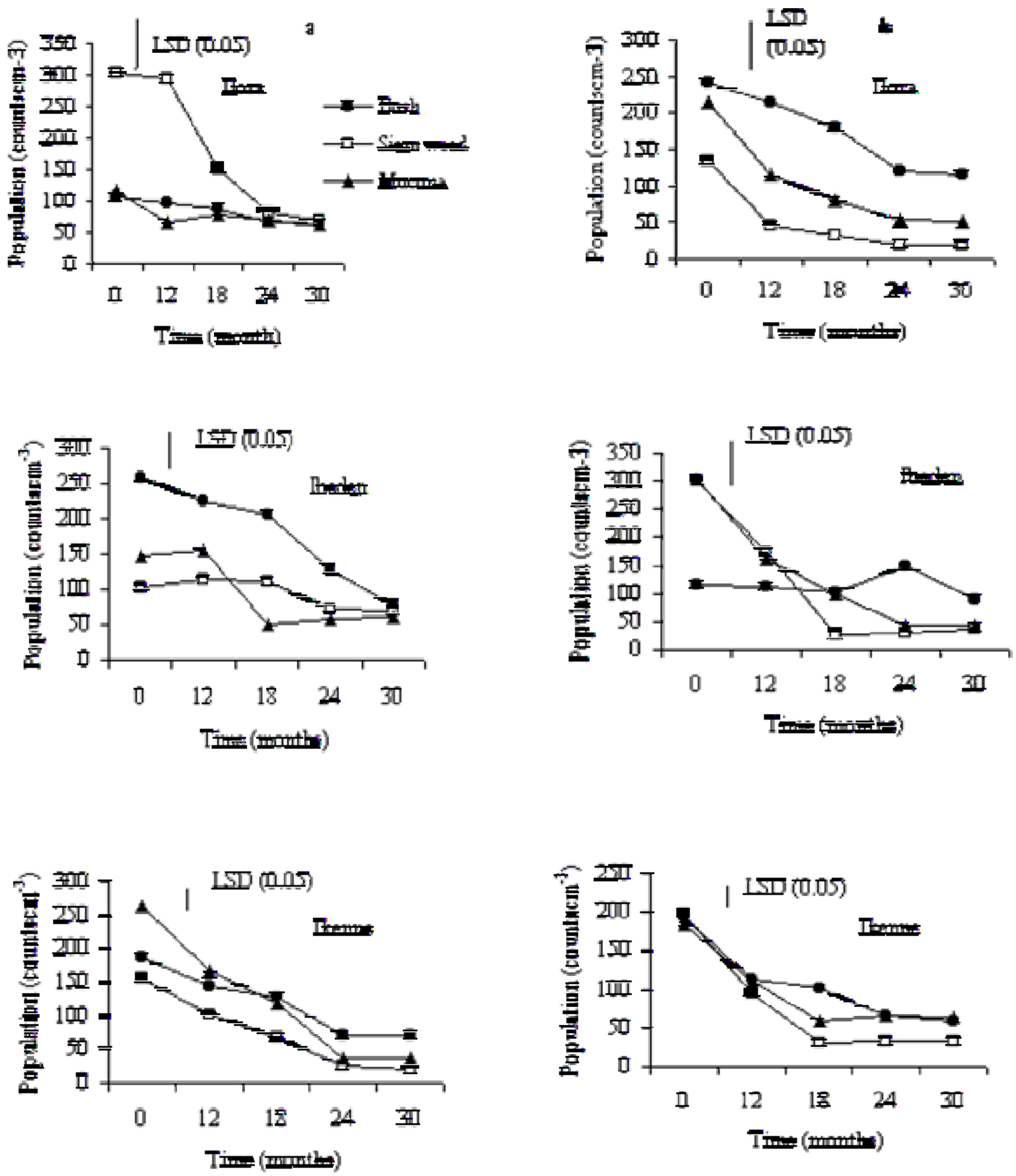


**Figure 1.** Effect of fallow crops on the population of plant-parasitic nematodes (a – *Meloidogyne*; b – *Pratylenchus*).

locations and species. At this period, the soils showed contained the highest total populations of nematodes (Figures 1 and 2.). It showed 25.8 and 14.3% greater populations than at Ikenne and Ibadan, respectively. Genera showing highest population counts at the three locations were the Pratylenchus (114-303), *Meloidogyne* (103-304), and *Helicotylenchus* (35-163), followed by *Tylenchorhynchus* (11-159), *Scutellonema* (8-96), and *Rotylenchus* (0-106) species. Other genera recovered (totalled 50-227 counts cm$^{-3}$) were *Xiphenema*, *Aphelenchus*, *Longidorus*, *Trichodorus*, and *Radopholus*. Highest populations were observed in soil at test initiation. After 12 months of bush fallow the major genera, *Meloidogyne*, *Pratylenchus* , and *Helicotylenchus*, remained dominant in the soil irrespective of the crops and locations.

The fallow crops reduced nematode populations at the different locations. Nematode populations generally decreased as fallow period increased (Figure 1). The highest reduction was observed at 12 and 24 months.

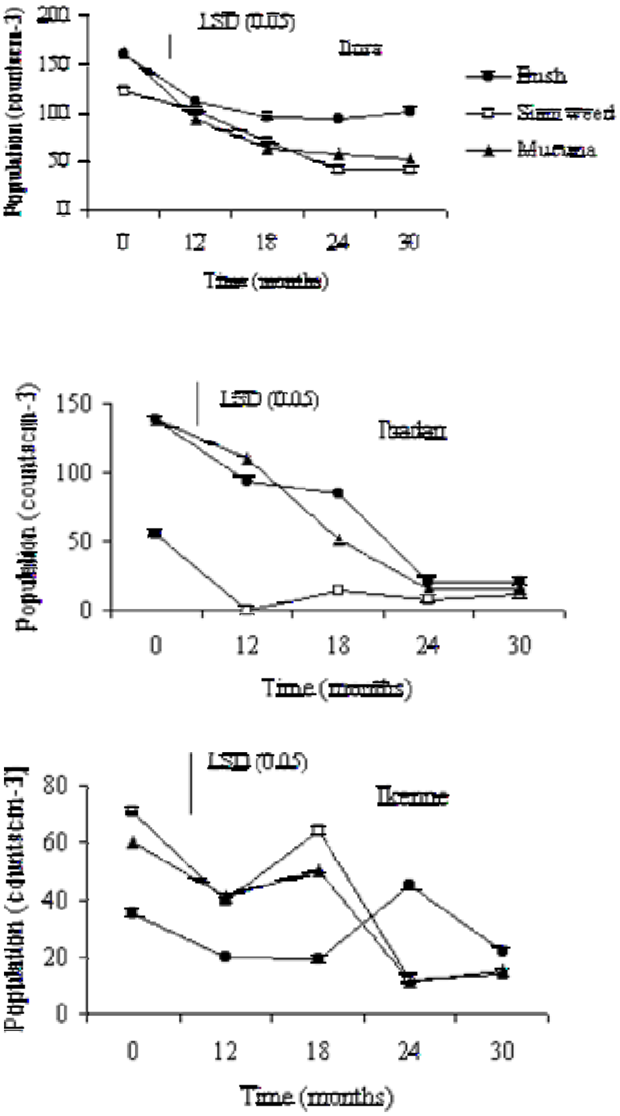


**Figure 2.** Effect of fallow crops on the population of plant-parasitic nematodes (*Helicotylenchus*).

Reduction in nematode populations, however, varied with species, fallow treatments and location of fallow. Sharp decrease in *Meloidogyne* population was observed with siam weed at Ilora after 18 and 24 months months, while at Ikenne, there was gradual decrease in *Meloidogyne* population as fallow period increased up to 24 months. No significant reduction in population observed with siam weed at Ibadan and with mucuna and bush at Ilora.

Sharp reduction in *Pratylenchus* population by siam weed and mucuna was observed at 12 and 18 months both in Ibadan and Ikenne. However, at Ilora significant reduction was observed only at 12 months. Mucuna also showed sharp reduction at 12 months but was followed by gradual trend at 12 and 18 months. High reduction in *Helicontylenchus* population due to mucuna and siam weed fallows was observed as from 12 months at Ilora (Figure 2). At Ibadan, mucuna and bush fallows gave almost similar trend while, siam weed did not show further reduction. At Ikenne, nematode population reduction due to crops was inconsistent as from 18 months of fallow. On the average, there was sharp reduction in nematode population 18 months and 24 months under siam weed across locations. This was closely followed by mucuna. The siam weed planting produced 52-65% reduction in populations while, the bush fallow showed 17-40% reductions. At 30 months, nematode suppression in the siam weed plot was high (67-79%) and was followed by mucuna with 64-72% and bush with 30-49% reduction.

Nematode suppression differed with location and nematode genera under the various fallow crops (Figure 3). For example, while *Meloidogyne* was reduced by 60% under siam weed at Ilora, the reduction under mucuna and natural bush was about 44 and 30%, respectively. This trend was similar to that for *Pratylenchus*, except that mucuna showed superiority over bush fallow. Contrary to results on *Meloidogyne*, mucuna gave higher suppression than siam weed at Ibadan, while at Ilora, both mucuna and siam weed suppressed *Pratylenchus* and *Helicotylenchus* better than bush at Ibadan. At Ikenne, however, mucuna and siam weed showed similar effects on *Meloidogyne* and *Helicotylenchus* while siam weed suppressed *Pratylenchus* better than other crops. On the average, mucuna and siam weed suppressed *Pratylenchus* more than other nematodes and there was 61-67%, 56-64% and 36-45% suppression of the major genera by siam weed, mucuna and bush, respectively across the trial locations.

## DISCUSSION

The variations in the composition and density of nematode might have been influenced by soil and vegetation at test initiation (pre-crop). Soils, climate and plant hosts could be major factors that resulted in fluctuations of nematode populations in this experiment. This was suggested in the report of Taylor (1971) and Fawole (1992) stressing that, environmental factors are of great importance in influencing fluctuation in nematode population.

It could be deduced from these results that, the population of nematodes in the soil varied from location to location and was reduced as fallow period progressed.

Although, soil treatment with nematicides is regarded as the most effective measure of suppressing nematode population, growing of non-susceptible plants has been found to be equally effective in some environments (Fawole, 1992; Rodriguez-Kabana et al., 1992). Planting

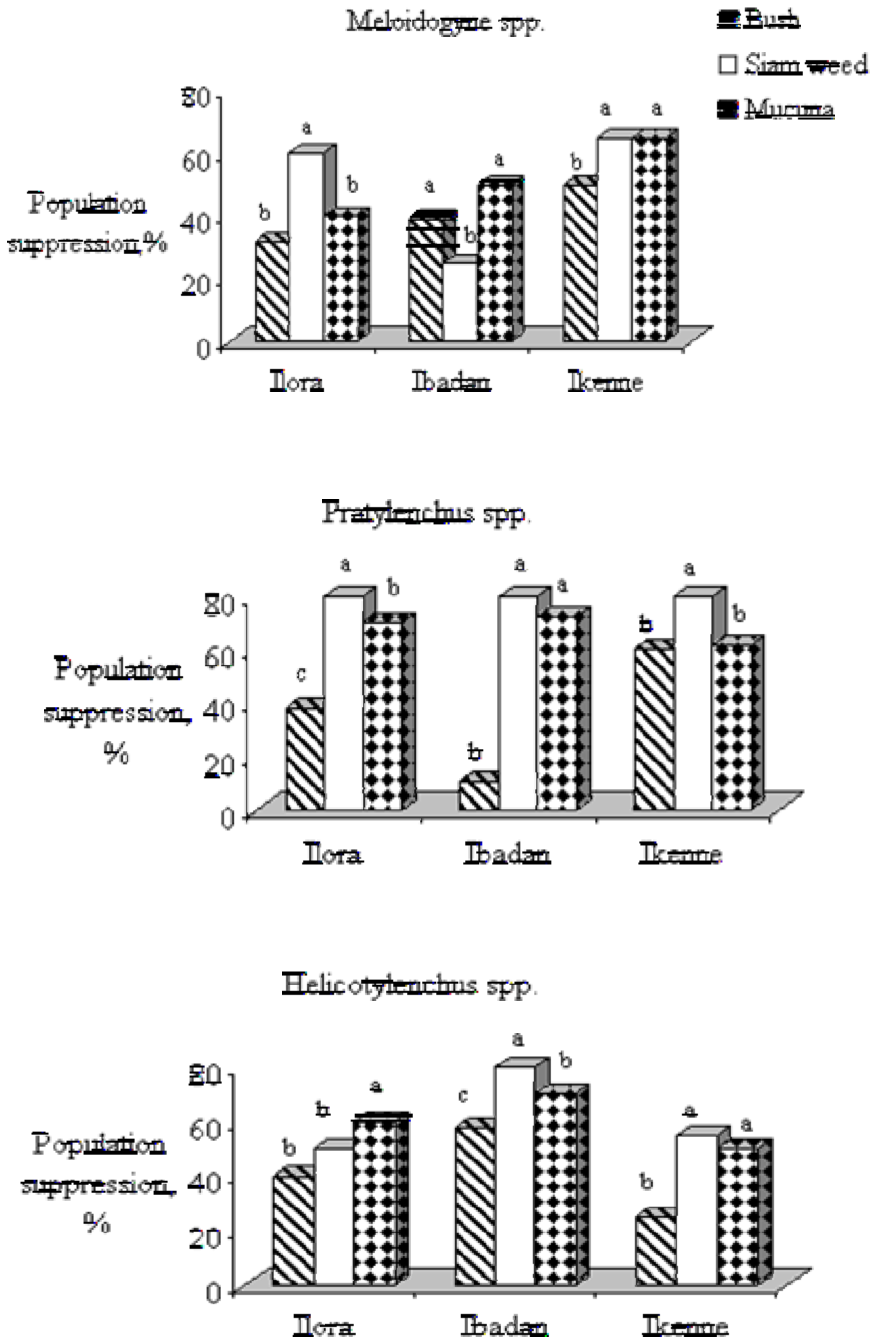


**Figure 3**. Effect of fallow crops on percent nematode suppression. Bars showing the same letters per location are not significantly different.

(Fawole, 1992; Rodriguez- Kabana et al., 1992). Planting of siam weed and mucuna was found in this study to be effective in nematode suppression. On the whole, nematode population decreased by up to 79 and 74%, respectively, with siam weed and mucuna after 30 months of fallowing, whereas the natural bush re-growth gave less than 50% reduction in population. Each of these crops was specifically more effective on certain nematode pests than the other and was location and soil specific. This indicates that, proffering solutions to problems caused by each nematode must be appro- ached individually in order to achieve desirable effects. Therefore, for effective nematode suppression with fallow cropping, proper determination of the principal nematode species predominant in an environment is very important. The synthetic nematicides are rarely affordable by most African farmers. When affordable, the farmer lacks the high technical skills required for their application. Siam weed is regarded as a weed on farms, and it is widespread in many parts of Nigeria. Mucuna is a non-economic plant that is commonly used to improve soil fertility. Both crop plants could be exploited for cultural management of nematodes such as *Meloidogyne*, *Pratylenchus* and *Helicotylenchus*. However, there is need to employ further investigations using the extracts from the crop plants in order to obtain the full benefits of their nematicidal properties, Meanwhile, both siam weed and mucuna could be exploited as measures of nematodes suppression by including them in fallow cropping or crop rotation systems.

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