Influence of Six Varieties of *Cynodon* on Four *Meloidogyne* spp.[1]

M. O. ADENIJI AND H. R. CHHEDA[2]

Abstract: Two years of giant star grass, *Cynodon nlemfuensis* var. *nlemfuensis*, in a field plot markedly reduced the incidence of the root-knot nematodes. Tomato planted following the grass showed very little or no root galling and the yield was thrice that of tomato planted on an adjacent field plot previously cropped to tomato. Replicated greenhouse experiments indicated that six varieties of *Cynodon* were resistant to root-knot nematode but it took up to 6 months of grass growth to appreciably lower the nematode population. The nematodes were eliminated from the soil by all the six grass varieties after 18 months. *Key Words: Cynodon nlemfuensis,* Giant star grass, nematode control.

Wide host range and rapid reproduction make the root-knot nematode a serious pest of most vegetable and field crops. Soil fumigation effectively reduces the initial nematode population density below the level of economic loss but it is expensive. Hence cultural methods need to be considered as possibly more economical and more desirable methods of control.

McBeth (6) evaluated sixteen southern grasses and reported that only 'Coastal' bermudagrass, *Cynodon dactylon* (L.) Pers., was resistant to root-knot nematodes although these results were not confirmed by Riggs *et al.* (9). Good *et al.* (5) reported that 'Coastal' bermudagrass might control root-knot nematodes but would increase the population of other destructive nematodes such as *Belonolaimus longicaudatus, Trichodorus christiei, Xiphinema americanum* and *Pratylenchus brachyurus.* A number of other grasses have been reported resistant to nematodes. (3, 4, 7.)

In 1969, tomatoes grown at the University of Ibadan Teaching and Research Farm on a plot of land previously cropped to a variety of giant star grass, produced a remarkably higher yield than those grown on an adjacent plot previously cropped to tomato. Roots of tomato plants grown after grass were almost free of galls as opposed to the severely galled roots of the tomato plants grown after tomato. This variety of giant star grass was a selection of *Cynodon nlemfuensis* var. *nlemfuensis*, Vanderyst, made by Chheda (1) at the University of Ibadan, Nigeria from material originally collected in the Lake Manyara area of Tanzania, East Africa. This grass proved to be much more productive than the local *Cynodon* and was released as cultivar 'IB8'.

These experiments were, therefore, undertaken to evaluate six of the *Cynodon* varieties developed by Chheda as crops that can be of practical value to use in the rotation system in Nigeria to reduce populations of root-knot nematodes.

MATERIALS AND METHODS

FIELD PLOT STUDIES: This experiment was carried out on a sandy loam at the University of Ibadan Teaching and Research Farm, Nigeria. The soil was naturally infested with four root-knot nematodes—*Meloidogyne incognita incognita* (Kofoid and White) Chitwood, *M. incognita acrita* Chit-

Received for publication 11 November 1970.

[1] This research was jointly supported by the Rockefeller Foundation and the University of Ibadan, Nigeria.

[2] Lecturer in Plant Pathology, Department of Agricultural Biology, University of Ibadan and Senior Lecturer, Department of Agronomy, University of Ibadan, Nigeria respectively.

wood, *M. arenaria* (Neal) Chitwood, and *M. javanica* (Treub) Chitwood. In 1967, a quarter of an acre of the vegetable plot on which tomato had been previously cropped was sodded to giant star grass selection 'IB-8' while a similar area adjacent to this continued to be cropped to tomato and some Cucurbitaceae also susceptible to root-knot nematodes. Two years later, the grass and other crops were removed and tomato was planted. Fertilizer was applied consistent with good practices for tomato production. The grass roots were examined microscopically for symptoms and for nematodes within the tissues. Tomato fruits were harvested at maturity and yields recorded. After the final harvest, the tomato plants were uprooted and rated for root galling on a scale from 0–4 (see footnote, Table 1).

GREENHOUSE STUDIES: The following six varieties or species of *Cynodon* were used:—*Cynodon nlemfuensis* var. *robustus* Clayton and Harlan, *C. nlemfuensis* var. *nlemfuensis* Vanderyst ('IB-8'), *C. nlemfuensis* var. *robustus* × *C. dactylon* var. *aridus* Harlan and de Wet., *C. aethiopicus* Clayton and Harlan, *C. dactylon* L. Pers. var. *coursii* (A. Camus) Harlan and de Wet, *C. nlemfuensis* 10565.

Two types of soil inoculation were employed; the first type resembled a situation similar to natural field plot infestation. Severely galled tomato roots were chopped into segments and mixed with garden soil collected from a plot cropped to two seasons of tomato. One hundred grams of this soil was used to extract root-knot nematode larvae by the Christie and Perry (2) modification of the Baermann funnel technique. The soil was distributed in greenhouse boxes (60cm × 45cm × 25cm) and the grasses were transplanted. The soil depth in each box was 20 cm. There were four replications of six transplants per box per variety of *Cynodon*. The grasses were allowed to grow at a soil temperature of 24–27 C. At 3-month intervals the grasses were trimmed and nematode counts made from 100-g soil aliquants randomly taken from each box. The grass roots were also examined microscopically for root-knot nematodes within the tissues. Ten tomato seeds were sown per box and after 15 days the plants were carefully uprooted and the number of galls counted. Fifteen days allowed formation of a good number of galls without the completion of a life cycle (egg to egg). The grasses were allowed to sprout again and the previous exercise was repeated at 3-month intervals for 18 months.

TABLE 1. Effect of growing *Cynodon nlemfuensis* ('IB-8') for two years on the tomato yield and root-knot nematode index[b] in field plots.

Rotation sequence	Tomato yield ton/acre[a]	Root-knot index[b]
Tomato after two yr of *Cynodon* ('IB-8')	6.8	0.1
Tomato after two yr of tomato	2.2	3.5

[a] average of 100 plants calculated to acre basis.
[b] Relative root-knot index: 0—No infection; 1—Light infection, small knots; 2—moderate infection, medium-sized knots; 3—severe infection, large knots, hardly any root free; 4—Very severe infection, large knots with most roots rotted.

The second type of inoculation was carried out in steam-sterilized garden soil in 15-cm clay pots. Each pot of soil was inoculated with *Meloidogyne* egg masses containing eggs and second stage larvae at the rate of about 1200 eggs per pot. The grasses were transplanted three seedlings per pot per variety and each was replicated four times. After 3 months the soil in each pot and the grass roots were examined as indicated above and then five tomato seeds were placed in each pot. The seedlings were rated for root galling after 15 days. The experiment was terminated after 3 months because there was no indication of presence of root-knot larvae in any of the pots. The tomato seedlings were also free of root-knot galling.

TABLE 2. Effect of greenhouse-grown *Cynodon* varieties on the population of root-knot nematodes in soil.

Cynodon varieties	Initial population per 100g/soil	*Meloidogyne* spp. larvae/100 g. soil				
		3 mo.	6 mo.	9 mo.	12 mo.	15 mo.
C. nlemfuensis var. *robustus*	240	11	1	0	0	0
C. nlemfuensis var. *nlemfuensis* ('IB-8')	240	10	0	0	0	0
C. nlemfuensis var. *robustus* × *C. dactylon* var. *aridus*	240	12	3	0	0	0
C. aethiopicus	240	39	2	2	0	0
C. dactylon var. *coursii*	240	27	5	3	0	0
C. nlemfuensis 10565	240	14	5	2	0	0

RESULTS

Two years of *Cynodon* 'IB-8' had almost completely eliminated root-knot nematodes from the field plots (Table 1). The grass roots were free of galls and no nematodes were observed within the root tissues. Almost all the tomato plants had clean roots free of root-knot galls as compared to the severely galled roots of tomato plants growing on the adjacent plot previously cropped to root-knot susceptible plants. The tomato fruit yield from the grass plot was thrice that from the plot previously cropped to tomato despite fertilization at equal rates.

Greenhouse studies in which grasses were grown in sterilized soil inoculated with egg masses containing eggs and second stage larvae of *Meloidogyne* indicated that the soil had become completely devoid of larvae after 3 months. The grasses were resistant to the nematode; they showed no sign of root galling nor were any stages of the nematode life cycle observed in the tissue of grass roots examined. Tomato seedlings following the grass also showed no sign of root galling. But the experiments in which grasses were grown in garden soil inoculated with galled tomato roots (Tables 2 and 3) indicated rapid reduction of the soil population of the root-knot nematode within a period of 3 to 6 months although it took at least 12 months for economic control of the root-knot nematode larvae by any variety of the grass. It,

TABLE 3. Effect of *Cynodon* varieties on the galling of tomato seedlings planted in soil infested with *Meloidogyne incognita acrita*.

Cynodon varieties	Age of *Cynodon* (months) at which tomato was interplanted					
	3	6	9	12	15	18
C. nlemfuensis var. *robustus*	28[a]	8	8	3	2	0
C. nlemfuensis var. *nlemfuensis*	123	14	13	4	2	0
C. nlemfuensis var. *robustus* × *C. dactylon* var. *aridus*	92	23	20	3	0	0
C. aethiopicus	57	22	7	1	1	0
C. dactylon var. *coursii*	52	21	8	7	0	0
C. nlemfuensis 10565	25	16	6	3	1	0

[a] Number of root-knot nematode galls on roots of 15-day-old tomato seedling (Average of 40 seedlings).

however, took 18 months of continuous growth to obtain tomato seedlings with clean roots completely free of root galls. A persistent creeping weed, *Portulaca, quadrifida,* which was very susceptible to root-knot nematode had to be continually removed from the grass by hand-pulling at the early stages of grass growth but later became suppressed after about 3 months when the grasses had formed a dense cover.

Discussion

Of the grass species tested by various workers, *Cynodon dactylon* has generally been considered resistant to root-knot nematodes and has been used in rotations as a sod crop preceding susceptible crops (7). Our data indicate that giant star grass, *Cynodon nlemfuensis* var. *nlemfuensis,* and the other five *Cynodon* varieties tested in this experiment would control root-knot nematodes. Although grasses grown on sterile soil inoculated with eggs and larvae of *Meloidogyne incognita acrita* were not infected and the nematodes were eradicated within 3 months, it took over 6 months to obtain appreciable nematode reduction and up to 18 months for eradication of the worms from garden soil infected with root-knotted propagules. This rather long period of time required for elimination of the nematode compared with inoculated sterile soil was undoubtedly due to the presence of the weed, *Portulaca quadrifida,* because nematode populations decreased quickly when the grasses provided enough ground cover to suppress the weed. It appeared that a pure stand of any of these *Cynodon* selections would effectively control root-knot nematodes. The absence of any stage of the root-knot nematode life cycle within the tissues of the grass roots indicated that the second stage larvae were unable to enter the roots and could not survive without food for a long period in the soil and hence the resulting reduction in their population. Giant star grass pastures have been found to be highly productive in parts of Southern Nigeria where they have produced live weight gains of about 300 lb per acre per head of cattle (8). Thus, land on which they are grown will be in economic use and in cover all the time. There seems to be a practical possibility of including these grasses in rotation programs with root-knot nematode susceptible crops.

Literature Cited

1. Chheda, H. R. 1968. *Cynodon* IB-8, improved variety of *Cynodon* suitable for pastures in Southern Nigeria. Proc. Agr. Soc. Nigeria. 5:46.
2. Christie, J. R., and V. G. Perry. 1951. Removing nematodes from soil. Proc. Helminthol. Soc. Wash. 18:106–108.
3. Daulton, R. A. C. 1963. The behaviour and control of root-knot nematode *Meloidogyne javanica* in tobacco as influenced by crop rotation and soil fumigation practices. Third World Tobacco Scientific Congress Proc., Salisbury, South Rhodesia.
4. Gaskin, T. A. 1958. Weed hosts of *Meloidogyne incognita* in Indiana. Plant Dis. Rep. 42:802–803.
5. Good, J. M., N. A. Minton, and C. A. Jaworski. 1965. Relative susceptibility of selected cover crops and coastal bermudagrass to plant nematodes. Phytopathology 55:1026–1030.
6. McBeth, C. W. 1945. Tests on the susceptibility and resistance of several southern grasses to the root-knot nematode, *Heterodera marioni.* Proc. Helminthol. Soc. Wash. 12: 41–44.
7. McGlohon, N. E., J. N. Sasser, and R. T. Sherwood. 1961. Investigations of plant-parasitic nematodes associated with forage crops in North Carolina. N. C. Agr. Exp. Sta. Tech. Bull. 148. 39 p.
8. Okorie, I. I., D. H. Hill, and R. J. McIlroy. 1965. The productivity and nutritive value of tropical grass/legume pastures rotationally grazed by Ndama cattle at Ibadan, Nigeria. J. Agr. Sci. 64:235–245.
9. Riggs, R. D., J. L. Dale, and M. L. Hamblen. 1962. Reaction of bermudagrass varieties and lines to root-knot nematodes. Phytopathology 52:587–588.