Author's Note. The intention of this review is to present the most significant information relating to plant nematology problems in tropical Africa. It was never intended to be a review of all the literature concerning plant-parasitic nematodes of this region. In general, taxonomic and faunistic studies have not been included because they seldom apply to the topic under consideration. Many subjective decisions were made as to whether or not to include a particular paper. I have attempted to include those which best applied to the subject. I apologize in advance for errors of omission. I also wish to express my appreciation to Dr. Michel Luc for reviewing this article and for his many constructive suggestions.

For the sake of simplicity, tropical Africa will be considered as that portion of the continent south of the Sahara — admitting that certain areas, primarily because of the influence of altitude, do not fit the precise definition of tropical. With the great variation in total rainfall, rainfall patterns, temperature, soils and altitude, virtually all cultivated crops are produced in this vast region. Thus, the scope of this paper includes a wide array of food crops important as locally consumed dietary staples, export fruits and vegetables, and oil, fibre and other industrial crops.

In recent years greater attention has been given to nematode problems in tropical Africa, but as was stated at a symposium on nematodes of tropical crops, knowledge of this subject lags behind that available in temperate climates because “nematologists and appropriate research laboratories are insufficient or non-existent in the humid tropics where plant nematodes and their damage are greatest” (Chiarappa, 1969). It is the purpose of this article to summarize briefly the present state of knowledge of economically important nematode problems in tropical Africa. Undoubtedly many additional problems will come to light as nematology research intensifies in the future; however, the examples and discussion presented below are sufficient to indicate that nematodes are frequently a limiting factor in crop production in many parts of tropical Africa.

Other reviews on nematode problems in the tropics have approached the subject on a crop by crop basis (Smart & Perry, 1968; Peachey, 1969) but because many of the most important pathogenic nematodes in tropical Africa have extensive host ranges, I prefer to present the material according to nematode genera.
The *Meloidogyne*, or root-knot nematode, problem is beyond doubt THE most important nematode problem in tropical Africa. Although many other pathogenic or suspected pathogenic genera occur within the region, none can approach the economic importance of species of *Meloidogyne* when the entire range of crops affected is considered. Luc (1968) stated that in the former French territories in tropical Africa, "the most widely distributed, and the most damaging nematodes are the different *Meloidogyne". A similar statement was made by Addoh (1971) concerning *Meloidogyne* in Ghana.

Species of *Meloidogyne* occur in every country in tropical Africa; a generalization based upon the fact that root-knot nematodes have been found in all African countries in which they have been sought. *M. incognita* and *M. javanica* are the forms most frequently identified (Luc, 1968; Whitehead 1969a).

An interesting aspect of the *Meloidogyne* problem in tropical Africa is the rapidity with which the problem becomes severe. From Kenya, Jackson (1962) has reported root-knot nematode damage to vegetables in the first crop planted on land not previously cultivated. Edwards (1953) reported complete failure of tomato in Ghana in the first season on freshly cleared land due to *Meloidogyne*. He traced the source of infestation to indigenous weeds that served as reservoirs of the nematodes. Whitehead (1969a) reported the occurrence of *Meloidogyne* in 37 of 51 samples from indigenous forests in East Africa. Leiper (1939) had previously pointed out that in Africa, traditional farming methods had not seriously increased soil-borne parasite problems, but that the introduction of the European system of intensive cropping led to an increase in plant parasite populations and to crop failures.

The taxonomy of this genus is extremely difficult. Whitehead (1969a), for example, has recorded 9 species from tropical Africa, primarily East Africa: *M. javanica, M. incognita, M. hapla, M. decalineuta, M. africana, M. megadora, M. kikuyensis, M. ethiopica,* and *M. arenaria*. In addition, *M. acronea* has been recorded in South Africa and Malawi (Coetzee, 1956; Bridge, et al., 1976). Notwithstanding arguments concerning the validity of some of these species, the point remains that the genus *Meloidogyne*, as represented in tropical Africa, consists of several morphologically distinct groups, that can be identified with some certainty. More importantly, each taxon has a distinct host range which may or may not overlap those of other taxa. Thus, it is not at all unusual for a single plant species to be attacked by several species of *Meloidogyne*. In attempting to reduce losses through cultural means, it is imperative to determine the host range of the population under consideration, even or especially if it consists of a mixture of species, which is frequently the case. Even if a monospecific population of *Meloidogyne* can be identified, considerable physiological intra-specific variation has been reported in tropical Africa so that one cannot depend with confidence upon the results of published host range data. To illustrate this point I cite the occurrence of biotypes of *Meloidogyne* capable of breaking resistance in tomato (Netscher, 1970; Taylor, 1975) and the occurrence of biotypes of *M. javanica* capable of attacking strawberry, a "non-host" of this species (Martin, 1962a; Taylor & Netscher, 1975). Thus, prior to implementing a crop rotation to reduce root-knot nematode populations, it is always prudent to test the reactions of the proposed rotational crops to the local *Meloidogyne* population. From the practical point of view, one must ask whether or not we are much further ahead today in understanding the *Meloidogyne* problem than when this group of pathogens was referred to as "*Heterodera marioni*" with several recognized physiological races.
As is true for most nematodes, accurate crop loss figures attributable to *Meloidogyne* are difficult to obtain. On the basis of soil fumigation experiments in Kenya, Ngundo and Taylor (1974) concluded that *Meloidogyne* could cause up to a 60% yield reduction in green beans. There are also well known cases in which species of *Meloidogyne* have caused total economic loss, i.e. unmarketable root crops or crops so badly damaged that harvesting was uneconomical. Luc (1968) cited an example from Senegal where it was impossible to produce tobacco in two consecutive years because of the presence of *Meloidogyne*.

Following are short summaries defining the extent of the *Meloidogyne* problem on several important crops of tropical Africa.

**Tobacco.** Luc (1968) has recorded “heavy” attacks of *Meloidogyne* on tobacco in Madagascar, Senegal and Ivory Coast. The most complete data on this crop comes from Rhodesia where Martin (1960) estimated that annual losses of tobacco due to *Meloidogyne* were £1,000,000. On the basis of a survey in 1961-62, Daulton (1962) stated that *Meloidogyne* was responsible for the loss of 18-25 million pounds (8-11,000 tonnes) of cured tobacco leaf per year. In addition he reported that 84% of tobacco seedbeds were fumigated annually, primarily for root-knot control, and that 46.8% of the total 224,000-acre tobacco crop was fumigated annually. In the 1963-64 season, 56.4% of the tobacco acreage was fumigated (Daulton, 1964). In Tanzania, tobacco losses were estimated to be 30% or more due to the attacks of *M. javarzica* and *M. incognita* (Whitehead & Ledger, 1961). The complex *Meloidogyne* problem on tobacco in Madagascar has recently been reviewed (de Guiran, 1970).

**Vegetable Crops.** Considered as a group, vegetables are among those plants most damaged by *Meloidogyne* in tropical Africa (Luc, 1968). Netscher (1970) maintained that *Meloidogyne* constituted the “main problem” for vegetable growers in Senegal and that members of this genus were commonly associated with tomato, eggplant, potato, cabbage, cauliflower, celery, red beet, leek, pepper, lettuce, parsley, carrot, okra, onion, cucumber, peas and beans. In South Africa, van der Linde (1942) considered that root-knot nematodes were the most serious pests of potato and other vegetables. At the eastern extreme of the region, *Meloidogyne* has been reported to cause severe damage to tomato, eggplant, carrot and red beet in the Seychelles (Mathias, 1971); and damage to beans in Kenya has already been mentioned (Ngundo & Taylor, 1974). From Ghana, Addoh (1968) reported yield reductions in tomato, potato, okra, yam and other vegetables when attacked by *Meloidogyne*. Many other examples could be cited to establish the point that a very serious *Meloidogyne* problem exists in vegetable production throughout tropical Africa, whether in established production fields or in fields recently cleared and put into production.

Vegetables differ in their susceptibility to *Meloidogyne*. Some crops, such as onion, are usually only slightly susceptible; others, like cabbage and cauliflower, are considered moderately susceptible; whereas, such crops as tomato, eggplant and lettuce are highly susceptible (Netscher & Luc, 1974). In addition, *Meloidogyne* resistance has been bred into certain tomato lines that are adapted to conditions in tropical Africa. However, as previously indicated, resistance-breaking biotypes are known to occur in the region. Nevertheless, in Senegal a resistant tomato variety, Rossol, yielded as well in non-treated *M. javarzica*-infested soil as a susceptible variety grown in nematicide treated plots (Netscher & Mauboussin, 1973).

**Cotton and other fibre crops.** Although *Meloidogyne* has been reported to
attack cotton in tropical Africa (eg. Buyckx, 1962), most attention has been
given to its association with Fusarium wilt. In Uganda, wilt symptoms appeared
on 50% of cotton plants 90 days after inoculation with Fusarium, whereas
symptoms appeared on 96% of those plants inoculated with both Fusarium
and Meloidogyne (Perry, 1961). In fields infested with both organisms, root-
knot damage and incidence of Fusarium wilt were both reduced by soil fumi-
gation. This relationship has also been reported from other countries, eg.
Tanzania (Perry, 1962) and Central African Republic (Luc, 1968). Perhaps direct
Meloidogyne damage has been overlooked because of the lack of typical symp-
toms on cotton. For example, in Malawi, M. acronea was found to be associated
with stunted cotton which was not galled but in which females were found only
partially embedded in the fine secondary roots (Bridge et al., 1976).

Kenaf, Hibiscus cannabinus, is known to be very susceptible to root-knot
nematodes (Addoh, 1970), but accurate loss figures are unavailable. The author
is aware of one case in East Africa in which Meloidogyne caused a total failure
of a large plantation of kenaf and the abandonment of kenaf cultivation in that
area. In some areas production of the related fibre crop, roselle (H. sabdariffa),
has been recommended since it is generally less conspicuously galled than kenaf.
For example, in Nigeria it was reported that each of the 28 varieties of kenaf
tested was susceptible to M. incognita, whereas the eight varieties of roselle
were resistant (Adeniji, 1970). In Ghana, on the other hand, both of these
fibre crops were rated as very susceptible to Meloidogyne (Addoh, 1970).
Severe attacks on both, as well as on other fibre crops, have been reported from

Fruit Crops. Tropical and subtropical fruit crops grown in Africa are generally
susceptible to root-knot nematodes, with the notable exception of citrus fruits
which are apparently rarely attacked. Luc (1968) has reported heavy damage to
pineapple in Ivory Coast; however in the presence of Pratylenchus brachyurus,
damaging populations of Meloidogyne are not commonly found on this crop
(Guerout, 1968). Papaya is known to be frequently damaged by Meloidogyne
(Guerout, 1969). Meloidogyne is also considered to be very damaging to banana
by certain workers (Ito, et al., 1972); however, multiple infections of banana
roots by several species of plant-parasitic nematodes make it impossible to assess
losses attributable to Meloidogyne. Root-knot nematode control in South Africa
resulted in an increase of up to 42% in yield of passionfruit (de Villiers &

Coffee, Tea, and Cacao. All of these three important export crops of tropical
Africa are susceptible to species of Meloidogyne. The subject has recently been
reviewed by Whitehead (1969b) from which it is concluded that the major
damage to coffee occurs in the seedbed and at the time of transplanting. White-
head maintained that coffee is highly resistant to M. incognita and M. javanica,
but that it is susceptible to such species as M. africana, M. decalinea and M.
megadora. Damage to mature trees is apparently uncommon.

A similar situation of mature plant tolerance or resistance also occurs in tea.
Tea seedlings are, however, susceptible to both M. javanica and M. incognita
(Whitehead, 1969b), and considerable damage occurs in seedbeds (Martin,
1962b); however, Martin reported only light infection on tea from 5-, 10-, and
35-year-old plantations.

Seedling damage in cacao occurs in tropical Africa, but tolerance of older
trees is generally recognized. An early report (Ghesquière, 1921) suggested that
Meloidogyne was the most important factor in die-back of cacao in Zaïre; how-
ever, research since that time has not supported that hypothesis.
Rice. Since most rice in tropical Africa is grown under paddy conditions, it is not surprising that under these largely anaerobic conditions \textit{Meloidogyne} injury is uncommon. In upland or dry-land rice, however, \textit{Meloidogyne} has been reported to cause damage (Vuông Huu Hai, 1972).

Sugarcane. \textit{M. javanica} and \textit{M. incognita} have been reported to cause considerable damage to sugarcane in South Africa. Affected plants were stunted, tillering was reduced, and drought and deficiency symptoms were present. Although soil fumigation increased the yield by as much as 14 tons per acre, this increase in crop value did not justify the cost of the treatment (Dick, 1961).

Cassava. Although cassava is a host of \textit{Meloidogyne} and has been reported to be attacked in Ghana (Edwards, 1953), it is less heavily galled than many other plants (Edwards, 1955). Luc (1968) stated that \textit{Meloidogyne} attacks are not serious unless cassava is interplanted with other very susceptible hosts.

Pyrethrum. This crop, grown at high altitudes in East Africa, is commonly damaged by \textit{M. hapla} (Whitehead, 1958); however, loss figures are not available.

Peanut. The \textit{Meloidogyne} “problem” in peanuts (\textit{Arachis hypogaea}) in tropical Africa is that little, if any, damage is caused to this crop despite the frequent identification of the “peanut root-knot nematode”, \textit{M. arenaria}, from this region. As early as 1917 growers in South Africa were advised to grow two crops of peanuts to reduce the incidence of root-knot on tobacco in Rhodesia (Rangeley, 1917). In East Africa, peanuts were immune to 20 isolates of \textit{Meloidogyne} tested (Whitehead, \textit{et al.}, 1963). More recently Netscher (1975) tested resistance of peanut to 18 isolates of \textit{Meloidogyne}. Although a few juveniles were recovered from peanut roots inoculated with five isolates, none reproduced when inoculated onto susceptible tomato. Previously it had been shown that peanuts actively reduce \textit{Meloidogyne} population in the soil (Netscher, 1974). Juveniles penetrated peanut roots, necrosis of root tissue occurred around them, and they apparently died. Very large populations of \textit{M. (cf) arenaria} caused extensive root necrosis and stunting of the tops, but reproduction did not occur. On the other hand, \textit{M. javanica} which normally does not attack peanut produced egg-laying females under field conditions in Rhodesia (Martin, 1956). Thus, in general, root-knot nematodes, including \textit{M. arenaria}, do not reproduce on peanut in tropical Africa; however, at least one isolate of a species not considered a parasite of peanut is, in fact, capable of reproducing on this crop.

Undoubtedly many other crops are damaged by root-knot nematodes in various parts of tropical Africa; others, such as coconut and oil palm, appear not to be affected. Despite these conspicuous gaps in knowledge, sufficient evidence is at hand to support earlier statements that \textit{Meloidogyne} is the most important group of plant-parasitic nematodes with which growers must contend in the region.

\textbf{Heterodera}

The genus \textit{Heterodera} is usually considered to be of economic importance to crops grown in temperate climates; however, recent reports indicate that members of this genus are or may become important in tropical Africa as well. Despite plant quarantine regulation, enforced to varying degrees, two species typical of temperate regions have been reported from this region: \textit{H. rostochiensis} from South Africa (Lochner, 1971) and \textit{H. schachtii} from Senegal (Luc & Netscher, 1974). The former has more recently been detected in additional fields in South Africa (Anon., 1973a) and may pose a threat to potato pro-
duction and that of another main crop (tomato) in the area. The *H. schachtii* infestation appears to be confined to a single garden within Dakar and is not considered a threat to other areas of vegetable production.

In addition, two species of *Heterodera* have been described from tropical Africa: *H. oryzae* (Luc & Berdon, 1961) and *H. sacchari* (Luc & Merny, 1963). Little is known of the economic importance of these species. *H. sacchari* has been identified from sugarcane in the Congo (Luc & Merny, 1963) and Nigeria (Jerath, 1968) and from rice in Senegal (Fortuner & Merny, 1973). Jerath (1968) reported that affected sugarcane plants were less than one-half the height of healthy plants. If this reduction in growth is attributable to *H. sacchari*, this species is potentially of great importance to the sugarcane industry. Although the biology and histopathology of *H. oryzae* in rice roots has been investigated (Berdon & Merny, 1964), its effects on rice yield have not been reported. An undescribed species of *Heterodera* has recently been reported from the Gambia where it parasitizes sorghum and millet (Merny, et al., 1974). In the light of the economic importance of these host plants, i.e. sugarcane, rice, sorghum and millet, and the recognized pathogenicity of other species of *Heterodera*, it seems logical to conclude that these species of *Heterodera* present in tropical Africa are capable of causing severe economic losses.

**Pratylenchus**

Root-lesion nematodes, the genus *Pratylenchus*, are among the most commonly occurring plant-parasitic nematodes and are known to cause extensive damage to a wide range of crops throughout the world. Reports indicate that this genus is widely distributed in tropical Africa and is associated with many plant species. Apparently *P. brachyurus* is the most widely distributed species and is reported frequently in surveys. Based upon its presence on the summit of Mount Nimba (Guinea) in non-cultivated soil, Luc (1968) considered it a member of the natural fauna of West African savannas, subsequently adapted to many of the crop plants introduced into the region. In a preliminary list of nematodes associated with plants in West Africa, Luc and de Guiran (1960) reported the recovery of *P. brachyurus* from the roots of 48 plant species, including such major crops as rice, peanut, pineapple, cotton, sugarcane, cacao, coffee, maize, yam, sweet potato and several vegetables. They concluded, justifiably, that this constituted proof of parasitism of these crops. Caveness (1967) also reported that *P. brachyurus* was widely distributed in Nigeria and associated with a wide range of crops, however it was rarely observed in a survey of vegetable crops in Senegal (Netscher, 1970).

*P. brachyurus* is the most damaging nematode of pineapple in Ivory Coast (Luc, 1968). It produces necrotic lesions and root destruction to such an extent on this crop that it can reduce the ability of species of *Meloidogyne* to reproduce successfully in the roots (Guerout, 1968). *P. brachyurus*, in combination with species of *Meloidogyne*, *Helicotylenchus* and *Criconemoides* reduced pineapple yields by 34% in the Ivory Coast (Guerout, 1971). *P. brachyurus* is a widely recognized pathogen of potato in South Africa. In addition to attacking the roots, it also produces purple-brown lesions up to 5 mm in diameter on tubers (Koen & Hogewind, 1967), which continue to develop during storage (Koen, 1967). After storage, infected tubers may become unsuitable for table use or seed, and when used as seed lightly infected tubers can spread this nematode.

A report from South Africa (Anon, 1973b) claimed that maize yields could be reduced 25% by *P. brachyurus*. In a study of population dynamics of *P. brachyurus* under maize in Nigeria, Egunjobi (1974) noted that yield reductions during three successive crops of maize were correlated with population increases.
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of this nematode. She suggested that the yield losses might be attributable to *P. brachyurus*. Caveness (1967) has also reported an increase of over 20% in maize yield when *Pratylenchus* sp. was controlled. *P. brachyurus* also reduces peanut yields by as much as 25% in South Africa (Anon., 1973b) and has been reported infesting peanut shells in Rhodesia (Anon., 1972). Control of *P. brachyurus* produced a 15% increase in cotton yield in Rhodesia (Anon., 1972); based upon research by de Guiran (1965) in Togo, this species is considered a threat to cassava production.

*P. zeae* also occurs on rice in the Ivory Coast (Merny, 1970) and it is also claimed to be a serious pathogen of rice in South Africa (Anon., 1972). Damage to rice by an unidentified species of *Pratylenchus* has been reported from Rhodesia where the degree of stunting was correlated with the size of the population (Martin, 1972). Damage to sugarcane roots has been attributed to *P. zeae* in greenhouse trials in South Africa (Anon., 1971). *P. sefaensis* has been reported to attack maize, millet, sorghum, rice and cotton in Senegal and the Gambia (Foruner, 1973). *P. coffeae* has been reported to attack *Coffea arabica* in Zaire (Bredo, 1934) and is present in Madagascar (Luc, 1968). An unidentified species of *Pratylenchus* is reputed to cause brown root rot of tobacco in South Africa (Milne, 1962). It has also been claimed that species of *Pratylenchus* are among the most damaging nematodes to banana in Ghana (Ito, *et al.*, 1972).

In summary, when one considers the wide distribution of the genus *Pratylenchus* in tropical Africa, the number of species recorded, the large number of crops with which this group is associated and its pathogenic potential, one may conclude that, after *Meloidogyne*, *Pratylenchus* may prove to be the cause of the greatest economic losses in tropical Africa.

**Radopholus**

*Radopholus similis*, the burrowing nematode, is the most widely distributed parasite of banana in the former French territories in tropical Africa (Luc, 1968). Blake (1969) stated that it “probably occurs in most areas of the world where bananas are produced commercially”. As an endoparasite known to invade and colonize banana rhizomes, movement of infected banana planting material has undoubtedly accounted for the widespread distribution of *R. similis*. A list of countries from which this species has been reported from tropical Africa would consist of all countries where it has been sought. Species of *Musa* constitute one of the most important groups of crops grown in this region, being used as a carbohydrate source (plantain), fresh fruit, an export crop, and as a substrate for beer and alcohol production. *R. similis* damage to banana consists of direct cortical damage, increased susceptibility to secondary pathogenic organisms, and a general weakening of the root system that makes plants susceptible to wind damage (Wehunt & Edwards, 1968).

For more than fifteen years, I.R.F.A. (Institut de Recherche sur les Fruits et Agrumes) has investigated control of nematodes, especially *R. similis*, on banana in Ivory Coast and Cameroon. Vilardebo (1974) has recently reviewed these studies which vividly demonstrate the damage caused by *R. similis* to banana in this region. Earlier in the program, DBCP (dibromochloropropane) was recommended to control *R. similis* and increase banana yields. More recently it has been shown that newer compounds are more effective. In one experiment in the Ivory Coast DBCP application increased banana yield by 22 tons per hectare (101% increase); prophos (“Mocap”) by 24.4 tons (112% increase); and phenamiphos (“Nemacur”) by 30.6 tons (141% increase) (Vilardebo, 1974). In another trial in the Ivory Coast, Vilardebo (1974) reported that in the first fruit cycle, prophos increased yield 188% and phenamiphos 211%.
On the same plots the yield increases during the second fruit cycle were even more dramatic; prophos giving a 300% increase and phenamiphos a 411% increase. If the yield from the phenamiphos-treated plots in the second cycle is considered as the maximum yield of banana under the conditions of the experiment, and that the difference in yield in the non-treated control plots is due to *R. similis* injury, it can be deduced that *R. similis* caused a yield reduction of 80%. This figure is probably inflated since the total biological and physiological effects of these compounds are not completely known. Nevertheless, these and similar data indicate that *R. similis* can and does cause enormous losses to banana production in tropical Africa.

*R. similis* has also been recovered from the roots of maize, tobacco, potato, rice, wheat, cotton, soybean, sugarcane, tea, and peanut that had been planted close to infected bananas (Martin, *et al.*, 1969). Of these crops, it was observed that peanut was severely attacked with the production of numerous lesions and a reduction in yield; large numbers of *R. similis* were recovered from infected tissues. Thus, it was concluded that *R. similis* poses a potential threat to peanut production in Rhodesia. Keetch (1972) reported severe damage caused by *R. similis* in inoculation trials on peanut, soybean, sorghum, maize and sugarcane; and moderate damage on roots of eggplant, coffee, tomato and potato. Martin (1971) also reported infection of potato by *R. similis* and production of necrotic lesions.

It should be noted that *R. similis* has not been reported attacking citrus in tropical Africa. Inoculations of *R. similis* from Rhodesia and South Africa on lemon have failed (Martin, *et al.*, 1969; Keetch, 1972).

**Hirschmanniella**

Two species of *Hirschmanniella* are believed to damage rice in tropical Africa: *H. oryzae* and *H. spinicaudata*. A yield reduction of about 25% has been cited for *H. spinicaudata* (Luc, 1968). In a recent report, non-inoculated rice yielded 40% more than rice infected with *H. oryzae* (Fortuner, 1974). Number of tillers, plant height, fresh weight, and number and weight of panicles were also greater in the non-inoculated plants. In the extreme western part of the region, *H. oryzae* has been reported to be widely distributed in Senegal and the Gambia (Fortuner & Merny, 1973); and it also occurs in Madagascar to the east (Luc, 1959). *H. spinicaudata* has been reported from Cameroon, Mali and the Ivory Coast to the east (Luc, 1968) and Senegal and the Gambia to the west (Fortuner & Merny, 1973). It is logical to assume that both species are widely distributed in tropical Africa between their reported easterly and westerly extremes, but data on their occurrence is fragmentary, eg. both species are known to occur in Nigeria (Caveness, 1967). In Senegal, Gambia and Mauritania, *H. oryzae* and *H. spinicaudata* coexisted frequently in the same field; however, *H. oryzae* occurred most abundantly in the northern part of the region and decreased to the south, whereas the opposite distribution pattern was found for *H. spinicaudata* (Fortuner & Merny, 1973; Fortuner, 1975).

**Rotylenchulus**

Species of *Rotylenchulus*, especially *R. reniformis*, are widely distributed in tropical Africa. Although the pathogenicity of this species is known in other areas of the world, there is little information as to the damage it causes in the region. Peacock (1956) reported that *R. reniformis* occurred on many food crops in Ghana; he considered tomato, tobacco, okra, eggplant, sweet potato, soybean and carrot as highly suitable hosts. In one case he inferred that very heavily parasitized tomato plants must have had their vigor impaired. In northern Nigeria
it was reported to be associated with the roots of tomato, wheat, carrot, potato and lettuce (Bridge, 1972). Caveness (1967) reported its occurrence throughout Nigeria associated with many plants. He was able to demonstrate a 22% increase in yield of cowpea after fumigation of plots infested with *R. reniformis*. Thus, with its wide distribution and large host range, the genus *Rotylenchulus* many prove to be very important in agricultural production in tropical Africa; however, reliable data are needed before any conclusion can be drawn.

**Tylenchulus**

*Tylenchulus semipenetrans* is considered by DuCharme (1969) to be “the most important nematode pathogen of citrus and is the cause of virtually immeasurable losses”. He also contended that *T. semipenetrans* has been or can be found in practically every citrus-producing country, and that its widespread distribution is due to the movement of infected planting material. Observations in tropical Africa support the latter contention: in Kenya *T. semipenetrans* was not observed in local citrus plantings originating from seeds, but was widespread on trees known to have been imported from South Africa (Taylor & Ngundo, 1973). Estimates of yield losses caused by this nematode are rare in the region, but in Rhodesia (Anon., 1973b) treatment of Seville oranges with DBCP produced a 13% yield increase. Since *T. semipenetrans* is known to cause damage, even “immeasurable losses” (DuCharme, 1969), in citrus production in other parts of the world, it is surprising that more attention has not been given to this nematode in citrus-producing regions of tropical Africa.

**Scutellonema**

Although the genus *Scutellonema* is widely distributed in tropical Africa, its importance to agriculture is not well known with the exception of *S. bradyis* on yam, *Dioscorea* spp. According to Bridge (1972) this is the most important nematode in yam culture. It is an endoparasite of periderm and subperiderm tissues and causes the production of necrotic layers within the tuber (Goodey, 1935). Detailed histopathological examinations have shown that *S. bradyis* damage is caused by removal of cellular contents and rupture of cell walls (Adesiyan, *et al.*, 1975). *S. bradyis* is considered as the incitant of yam dry rot because lesions it causes are readily invaded by dry rot fungi, such as species of *Fusarium*. Such tubers are very susceptible to invasion by various other pathogens giving rise to wet rots during storage (Adesiyan, *et al.*, 1975). *S. bradyis* is widely distributed in Nigeria where as much as 50% of the world’s yam production is centered. In a survey of local markets in Western State, Nigeria, 43% of tubers examined were infected (Bridge, 1972). Precise loss figures are not available; however, a 10-20% yield reduction was reported in Ivory Coast (Baudin, 1956). *S. bradyis* reportedly can reduce tuber size and, as described above, causes further loss by its involvement in deterioration of tubers during storage.

Two other species of *Scutellonema* are widely distributed in tropical Africa: *S. brachyurus* and *S. clathricaudatum*. Luc (1968) concluded that *S. brachyurus* was potentially damaging to sugarcane in Madagascar his conclusion being based on the correlation between nematode populations and poor sugarcane growth. Another species, *S. cavenessi*, commonly associated with peanut, millet, and sorghum in the Sahelian area of Senegal, is of interest because it can survive the 8-month dry season in the soil in a dehydrated condition (Demeure, 1975).

**Helicotylenchus**

Members of the genus *Helicotylenchus* are frequently encountered in tropical
Africa; however, little is known of the damage they cause to crops. Some species of *Helicotylenchus* are claimed to cause damage to banana in the Ivory Coast (Luc & Vilardebo, 1961), in South Africa (Anon., 1962) and in Ghana (Ito, *et al.*, 1972). Whitehead (1959) suggested that the genus might be important to sugarcane, and it is a common associate of sugarcane roots in Mauritius (Williams, 1961) and Madagascar (Luc, 1968). Species of *Helicotylenchus* were reported to reduce root weight of oil palm seedlings, but after 16 months no differences in plant height were detected (Caveness, 1967).

**Hoplolaimus**

The genus *Hoplolaimus* occurs throughout tropical Africa, but as is true for so many other nematodes its economic importance has not been studied in detail. In Nigeria, *H. seinhorsti* was found associated with severely damaged roots of cowpea, *Vigna sinensis*. Cortical necrosis occurred in those parts of the roots invaded by *H. seinhorsti*, and after 9 weeks most of the feeder roots were badly damaged or missing (Bridge, 1973). The presence of the same species in the roots of rice, tomato, melon, okra and pigeon pea suggests that considerable damage may also occur on these crops.

**Aphasmatylenchus**

A species of *Aphasmatylenchus*, *A. straturatus*, has been associated with chlorosis of peanut, soybean, *Vigna*, *Tephrosia* and *Cajanus* in Upper Volta (Germani, 1972). It was later reported that chlorotic plants had reduced root systems and less nodulation; up to 100% yield losses occurred (Germani & Dhery, 1973). A strong correlation exists between population levels of *A. straturatus* and the chlorotic condition of these legumes. When nematicides were applied in areas where chlorosis existed, both *A. straturatus* populations and disease symptoms were reduced in the following crop. Duplication of disease symptoms by inoculation have been only partially successful to date.

**Anguina**

The genus *Anguina*, which usually causes galling of above-ground plant parts, has been reported from Africa, eg. *A. hyparrheniae* on *Enteropogon macrostachyus* in Kenya (Bock, *et al.*, 1970). However, *Anguina* appears to be more of a curiosity than an economic problem except, perhaps, in South Africa where *A. tumefaciens* may damage lawn grasses (van der Linde & Greenstein, 1938).

**Ditylenchus**

*D. angustus*, an important pathogen of rice, is widely distributed in the rice-producing areas of Madagascar with the exception of the west coast (Vuong Huu Hai, 1969). Plants are stunted with malformed panicles and leaf sheaths; spikelets are frequently sterile. Although exact loss figures have not been calculated in Madagascar, in other parts of the world losses of 50-90% have been reported.

The stem nematode, *D. dipsaci*, has been reported from southern Africa, but at higher elevations in a temperate climate.

**Aphelenchoides**

*A. ritzemabosi* has been reported to attack ornamental plants in Madagascar (Orian, 1957) and South Africa (Wager, 1972), and it is an economically important pathogen on pyrethrum, *Chrysanthemum cinerariaefolium*, in the highlands of
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East Africa (Whitehead, 1958). Quantitative loss figures are not available; however, since this nematode attacks the floral parts from which pyrethrum insecticide is extracted, it can be inferred that losses are high in heavily infested plantings.

Although *A. besseyi* was first reported on rice in Africa in 1966 (Hooper & Merny, 1966), its association with local rice varieties suggests that it has been present for a much longer time (Barat *et al.*, 1969). Surveys since that time have demonstrated the presence of *A. besseyi* in most countries of tropical Africa (Fortuner & Orton Williams, 1975). On the basis of research from other parts of the world (see Fortuner & Orton Williams, 1975 for a thorough review), *A. besseyi* can reduce rice yields by up to 70% under optimum conditions. According to Barat *et al.*, (1969) the parasite was detected before serious economic losses had occurred. This appears to be a bit optimistic in the light of reported “white tip” symptoms observed in Madagascar (Vuong Huu Hai, 1969) and Sierra Leone (Terry, 1972) and a reported 82% infestation of a seed lot from Tanzania (Taylor *et al.*, 1972). However, experimental evidence is needed to determine the magnitude of loss of rice production in those areas known to be infested.

**Concluding Statements**

Information has been presented on our knowledge of economically important problems in tropical Africa attributable to 14 nematode genera. Many other plant-parasitic genera have been reported from this region, eg. *Criconemoides, Paratylenchus, Hemicyclophora, Hemicriconemoides, Trogphasus, Tylenchorhynchus, Telotylenchus, Tetrylenchus, Rotylenchoides, Dolichodorus, Xiphinema, Longidorus, Trichodorus*, etc. (Luc & de Guiran, 1960; Caveness, 1967). Although members of these genera have been demonstrated to damage various crops in many other parts of the world, their economic importance in tropical Africa is completely unknown. It seems superfluous to say that a tremendous amount of research is urgently needed before the full extent of nematode damage to crops in tropical Africa can be assessed. Yet that is the case. In addition, a major effort must be made to develop efficient and economical methods of nematode control in the region utilizing all methods available. If maximum agricultural production in tropical Africa is to be achieved, the plant-parasitic nematode problems must be delineated and solved. That is the role of nematologists working in tropical Africa today and in the future.
REFERENCES


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