

RHADINAPHELENCHUS COCOPHILUS
ASSOCIATED WITH LITTLE LEAF OF COCONUT
AND OIL PALM¹

Met een samenvatting:

Rhadinaphelenchus cocophilus in kokos- en oliepalmen,
aangetast door „little leaf”

BY

H. A. VAN HOOFF² and J. W. SEINHORST³

INTRODUCTION

The term “little leaf” is generally used in the literature on diseases of coconut palm (*Cocos nucifera* L.) and oil palm (*Elaeis guineensis* Jacq.) to indicate disorders characterized by the leaves being much reduced in size and standing stiffly upright. According to STELL (1930) little leaf is the only leaf disease of economic importance in coconut palm in Trinidad and Tobago. In one grove in Trinidad 24 out of 149 trees were attacked (ANONYMUS, 1953). Little leaf is also an important disease of oil palm in the southern part of the Congo (20 to 25% of the trees attacked), but of little importance in the northern part of that country (KOVAVICH, 1952). It also occurs in Venezuela (MALAGUTTI, 1953) and most probably in Brazil (DA MATTA, 1956) and Sumatra (DONKERSLOOT, 1955).

The literature contains various opinions on the cause of little leaf. For coconut palm, ASHBY (1917) ascribed it to attack by a yeast, BRITON-JONES (1940) to *Phytophthora* and MARTYN (1945) to feeding by beetles and other insects together with *Phytophthora*. For oil palm, *Thielaviopsis basicola* (ANONYMUS, 1948), a physiological disorder (KOVAVICH, 1952, 1953), and boron deficiency (FERWERDA, 1954; BROESHART, 1955) have been mentioned as possible causes. None of these opinions is adequately supported by observations or results of experiments. Symptoms similar to little leaf were obtained in coconut by damaging young leaves with a knife (BRITON-JONES, 1940) or by pouring chemicals on the growing point (MARTYN, 1945).

Little leaf of oil palm has been studied extensively by KOVAVICH (1952, 1953), who gives a detailed description of the symptoms and development of the disease. He found that most attacked palms were six to twelve years old, although occasionally two year old palms already showed symptoms. He considers little leaf and bud rot to be different symptoms of the same disease, little leaf being the primary symptom, also shown by the first leaves developing after recovery from bud rot. In his opinion *Phytophthora*, which is associated with bud rot, is therefore not the cause either of this disease or of little leaf. As no other organisms were found and recovery of diseased trees seemed to exclude a virus as the pathogen, he assumes that little leaf is the result of a physiological disorder. Re-

¹ Accepted for publication 23 July, 1962.

² Agricultural Experiment Station, Paramaribo, Surinam.

³ Institute for Phytopathological Research, Wageningen, The Netherlands.

planting after cutting down old trees resulted in more little leaf than planting in between old palms. Application of fertilizer, especially when combined with felling of old trees, favoured outbreak of the disease, which is in contradiction with experience in Trinidad, where application of nitrogen reduced the severity of the attack (ANONYMUS, 1953).

FERWERDA (1954), BROESHART (1955) and BROESHART, FERWERDA & KOVAVICH (1957) used the term little leaf to indicate the symptoms of boron deficiency. However, in many cases (KOVAVICH, 1953; ANONYMUS, 1957) boron was found to be ineffective against little leaf. The symptoms of boron deficiency in the Congo were different from those of little leaf in Nigeria, where the disorder was not associated with boron deficiency (ANONYMUS, 1959). Further KOVAVICH (1953) observed that trees affected by little leaf recovered during the dry season. The symptoms of boron deficiency, however, would be most severe during the dry season. Little leaf and boron deficiency are therefore different diseases.

CHESQUIÈRE (1939) suggested that bud rot, which is often thought to be associated with little leaf (KOVAVICH, 1952, 1953), is caused by a species of *Aphelelenchoides* (*Rhadinaphelenchus*?).

An extensive review of the literature on little leaf and bud rot is given by BULL & ROBERTSON (1959).

DESCRIPTION OF LITTLE LEAF IN SURINAME

In Surinam little leaf was only rarely seen in coconut palms but it was fairly common in oil palms. Generally one percent or more of the trees in oil palm groves were attacked.

In both coconut and oil palm, diseased trees could easily be recognized by their erect, short and often deformed leaves (figs. 1 and 2). Closer inspection of these leaves revealed that the top part of the main vein bore suberized patches especially on the inner side of the leaf stalk. The pinnae were shorter than normal, mostly wavy, and often damaged and necrotic at the tips; sometimes they were necrotic all over or even absent, leaving a bare midrib, which was sometimes no more than 25 cm long (fig. 3). In some cases the attack resulted in a rot of the growing point, which ultimately killed the tree. In most cases the attack was a temporary one followed by complete recovery. Deformed leaves were found very close to the growing-point. Generally the first symptoms of attack were found on leaves from 2.5 to 4 cm long. They consisted of yellow patches, some millimetres in diameter, on the petiole and leaf base (fig. 4). The discoloured tissue distinctly protruded from surrounding healthy parts. Microscopical investigation revealed that in the yellow patches the cells were abnormally small (fig. 5). In slightly larger leaves the folded pinnae were also yellow, which colour rapidly changed to grayish in still older leaves (fig. 6). The leaf then withered. The discoloured patches on older petioles and especially on the midribs were often several centimeters in diameter.

RHADINAPHELENCHUS COCOPHILUS (COBB) IN AFFECTED TREES

In both coconut palm and oil palm fairly large numbers of nematodes of the species *Rhadinaphelenchus cocophilus* (Cobb) were found on discoloured tissue

of young (up to 1.75 m long) folded leaves, which was still protected from the sun. No nematodes were found on the suberized patches of unfolded leaves. The heavier the attack the more nematodes were present. They were only rarely found on the white healthy parts of diseased young leaves. Thus the nematodes apparently live ectoparasitically in the buds of the palms.

Of fifty diseased oil palms cut for investigation, only one did not contain nematodes. The symptoms of this tree differed from those described above, e.g. in that necrotic spots were found in the stem near the leaf bases at about 2.5 cm from the growing point.

Of seven coconut palms showing typical symptoms of little leaf five contained appreciable numbers of *R. cocophilus* on the youngest leaf. These five trees, which were 8 to 12 m tall, had already been attacked for a long time. The core of their trunks at one meter from the ground consisted of reddish dry tissue but there was no discoloration at 30 cm below the growing point. No eelworms were found in the red tissue and no red ring was ever seen either in coconut or in oil palm. The other two trees had symptoms only in the older leaves. The younger leaves were healthy and only very few nematodes could be collected from them. The stems of these trees were also healthy. Possibly a tree may recover from little leaf during the dry season if the trunk is not weakened.

Rhadinaphelenchus cocophilus was never found on the young leaves of numerous trees that did not suffer from little leaf but were cut for other reasons.

From all these observations it may be concluded that there is so close a correlation between the occurrence of little leaf and the presence of *R. cocophilus* on the young leaves of coconut and oil palm that this nematode can be suspected as being the cause of the disease. As the same nematode causes red ring, a relation between the occurrence of this disease and little leaf can be expected. MALAGUTTI's (1953) observation that in a seven year old oil palm grove suffering from little leaf many trees had died, apparently from red ring, may therefore mean more than a mere coincidence.

INOCULATION EXPERIMENTS

Inoculation of eight two year old oil palms with *R. cocophilus* during the dry season, did not result in the development of little leaf. The experiment was repeated during the wet season. On 13 October 1960 five oil palms, in a plantation where little leaf had never been noticed, were inoculated by dropping a nematode suspension on the young leaves. After some time one palm showed the typical symptoms. It was felled for closer inspection fifteen months after the inoculation. The characteristic discoloration and swelling appeared to be present on the young leaves and numerous specimens of *R. cocophilus* were found on them.

COMPARISON BETWEEN LITTLE LEAF IN SURINAM AND IN OTHER COUNTRIES

During a visit to British Guiana in December 1961 the first author saw coconut palms with little leaf in several localities. In Cane Grove a tree was felled for closer investigation. The typical symptoms and the nematode *R. cocophilus* were found on the young leaves.

According to photographs in various publications the appearance of little

leaf in countries other than Surinam is sometimes strikingly similar to the symptoms described above. However, KOVAVICH (1952) describes rotting of the young leaves at a late stage of the disease in the Congo. Neither this, nor the abnormal meristem he found in trees that had recovered from little leaf and bud rot, were seen in Surinam. Bud rot occurs in Surinam both in coconut and in oil palm but is not associated with little leaf symptoms as described in this article. The first leaves formed by a tree recovering from bud rot are smaller than normal but necrotic or suberized patches are absent. Possibly these symptoms were called little leaf in those cases where the latter is said to be closely associated with bud rot. *R. cocophilus* was never found associated with bud rot, which must therefore have a different cause.

Whether in countries other than the Guianas *Rhadinaphelenchus cocophilus* is associated with little leaf as described above or bud rot (CHESQUIÈRE, 1939) can only be disclosed by the investigation of diseased material.

DISTRIBUTION OF LITTLE LEAF IN SURINAM

In coconut palm little leaf was only found in the coconut district Coronie. The diseased trees (about 3 per 1000 trees) were scattered through the groves. Most coconut palms are growing on sandy soil. A tree which had recovered from little leaf was found on clay soil.

In experimental oil palm plantations in Surinam, which are all six to nine years old, the disease was fairly frequent in the Lelydorp scheme and surrounding area on the old coastal plain 30 km south of Paramaribo. From 1 to 19 % of the trees were attacked in the different groves. Again the diseased trees were scattered at random in the groves. Neither our own observations on soil type nor comparison of the distribution of little leaf with the soil map of this area by HENDRIKS & GLAVIMANS (1953) revealed a relation between soil type and occurrence of the disease in oil palm. The highest percentage of diseased trees (19 %) was found in a grove on very good loamy sand rich in organic matter (an old Indian settlement). In three groves on a very poor sandy soil the palms did very well and only a few suffered from little leaf. If the disease were connected with boron deficiency it would have occurred especially on this soil type.

No attacks were found on the young coastal plain on clay soil, but little leaf did occur there on sandy soil in the garden of the Agricultural Experiment Station at Paramaribo.

We thank DR. J. B. GOODEY for supplying specimens of *Rhadinaphelenchus cocophilus* for comparison.

SUMMARY

The presence of *Rhadinaphelenchus cocophilus* on the young leaves of oil palm and coconut palm was consistently associated with typical little leaf symptoms. Red ring, which is caused by this nematode, was not observed in Surinam. Little leaf, associated with the presence of *R. cocophilus* on the young leaves, was also found in British Guiana. One of several inoculations of oil palms with *R. cocophilus* resulted in the development of typical symptoms.

SAMENVATTING

In Suriname wordt bij kokospalm en meer nog bij oliepalm het verschijnsel „little leaf” waargenomen (fig. 1 en 2). De verkurking, vooral van de binnenzijde van de bladsteel, en de bladmisvormingen die hierbij optreden, kunnen zeer sterk zijn (fig. 3). Deze misvormingen blijken reeds te beginnen bij zeer jonge bladeren van 2,5 tot 4 cm lengte (fig. 4). Op hun bladstelen komen lichtgele, verhoogde plekken voor; de cellen zijn hier abnormaal sterk gedeeld en klein (fig. 5). Op deze plekken bevinden zich veel aaltjes buiten op het weefsel. Bij iets oudere bladeren worden de aaltjes ook op de jonge bladslippen aangetroffen. Als gevolg van de beschadiging in een jong stadium groeien de bladeren slecht, soms in het geheel niet meer uit. Het gevonden aaltje bleek steeds de soort *Rhadinaphelenchus cocophilus* (Cobb) te zijn. Het is bekend als de veroorzaker van „red ring” bij kokos- en oliepalm. „Red ring” werd in Suriname echter nooit opgemerkt, terwijl „little leaf” bij palm op kleigronden niet werd waargenomen. Buiten Suriname werd door ons in Brits Guyana „little leaf” in combinatie met hetzelfde aaltje geconstateerd.

Inoculatie van acht oliepalmen van twee jaar oud door een suspensie van de aaltjes in het groeipunt te gieten, had geen resultaat; van vijf geïnoculeerde oliepalmen van acht jaar oud vertoonde er één na tien maanden duidelijke ziektesymptomen.

Vijftien maanden na de inoculatie werden de typische beelden op de jonge bladeren van deze palmen geconstateerd, benevens grote aantallen aaltjes. Bij andere palmen van deze aanplant op klei werd geen „little leaf” waargenomen.

REFERENCES

- ANONYMUS, - 1948. I.N.E.A.C. Rapp. ann. Exerc. 1947: 43.
ANONYMUS, - 1953. Adm. Rep. Direct. Agric. Trinidad and Tobago for the year 1952: 34.
ANONYMUS, - 1957. Fifth ann. Rep. W. Afr. Inst. Oil Palm Res. 1956-1957: 100.
ANONYMUS, - 1959. Seventh ann. Rep. W. Afr. Inst. Oil Palm Res. 1958-1959: 19 and 104.
ASHBY, S. F., - 1917. Leaf bitten diseases of coconuts. Dept. Agric. Jamaica, leaflet.
BRITON-JONES, H. R., - 1940. The diseases of the coconut palm. London.
BROESHART, H., - 1955. The application of foliar analysis in oil palm cultivation. Thesis, Wageningen.
BROESHART, H., J. D. FERWERDA & W. G. KOVAVICH, - 1957. Mineral deficiency symptoms of the oil palm. Plant & Soil 8: 289-300.
BULL, R. A. & J. S. ROBERTSON, - 1959. The problems of little leaf of oil palm - a review. J. W. Afr. Inst. Oil Palm Res. 2: 355-375.
CHESQUIÈRE, J., - 1939. Rapp. ann. Exerc. 1939. Div. Phytopath. Publ. I.N.E.A.C. hors série: 521.
DONKERSLOOT, M. E., - 1955. Misvormingen bij oliepalmen. Bergcultures 24: 267-278 and 295-304.
FERWERDA, J. D., - 1954. Boron deficiency in oil palm in the Kasai region of the Belgian Congo. Nature 173: 1907.
HENDRIKS, J. A. H. & E. J. H. GLAVIMANS, - 1953. Bodemkartering van het Lelydorpplan en omgeving. Surin. Landb.: 106-113.
KOVAVICH, W. G., - 1952. Little leaf disease of the oil palm (*Elaeis guineensis*) in the Belgian Congo. Trop. Agric., Trin. 29: 107-141.
KOVAVICH, W. G., - 1953. Ditto, part 2. Trop. Agric., Trin. 30: 61-69.
MALAGUTTI, G., - 1953. Pudricion del colgollo de la Palmera de aceite africana (*Elaeis guineensis* Jacq.) en Venezuela. Agronomia tropical 3: 13-31.
MARTYN, E. B., - 1945. Coconut diseases in Jamaica 2. Diseases affecting the leaves, crown and stem of coconuts. Trop. Agric., Trin. 22: 69-76.

- MATTA, E. A. F. DA, – 1956. Sobre o „envassouramento” ou „ma hêamento” do dendezeiro (*Elaeis guineensis* Jacq.) na Bahia, Brasil. Bolet. Inst. biol. Bahia 3: 113–123.
- STELL, F., – 1930. Notes on the diseases of coconuts in Trinidad and Tobago. Dept. Agric. Trinidad & Tobago.



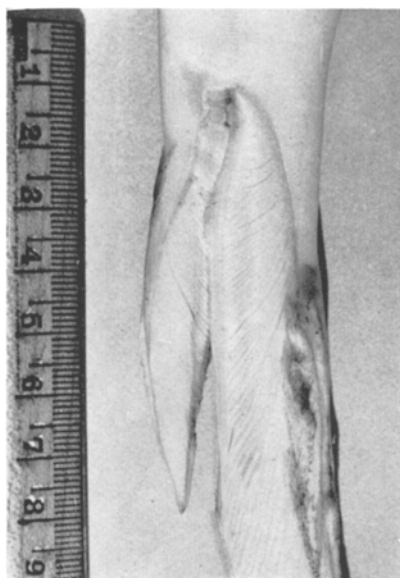
FIG. 1.
Coconut palm at Coronie with typical little leaf
symptoms.
*Kokospalm in Coronie met typische „little leaf”-
symptomen.*



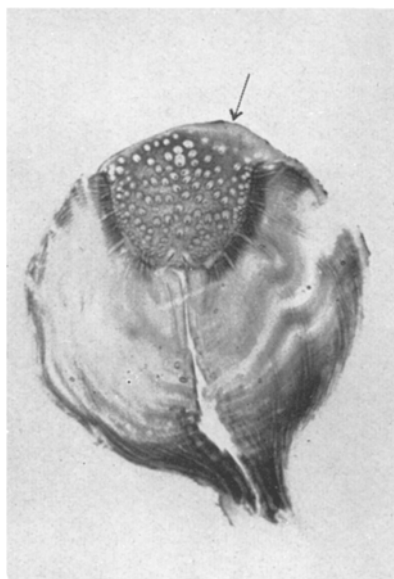
FIG. 2.
Oil palm with little leaf.
*Oliepalm op het Lelydorpplan
met „little leaf”.*



FIG. 3.
Deformed leaves of oil palm
with symptoms of little leaf.
*Misvormde bladeren van een
oliepalm met „little leaf”-ver-
schijnselen.*



4



5



6

FIG. 4. Young leaf of oil palm; diseased patches associated with presence of *Rhadinaphelenchus cocophilus*.

Jong blad van een oliepalm met door aaltjes veroorzaakte aantastingsplekken.

FIG. 5. Cross section of young leaf of oil palm. On the midrib a swollen diseased patch (marked with an arrow), where the tissue consists of small cells.

Dwarse doorsnede door een jong blad van oliepalm. Op de bladsteel werd een aaltjesplek getroffen. Het weefsel (aangeduid met een pijl) is hier opgezwollen en kleincellig.

FIG. 6. Older leaf of oil palm with necroses associated with presence of *Rhadinaphelenchus cocophilus* on young leaves.

Ouder blad van oliepalm met necroses, samengaan met de aanwezigheid van Rhadinaphelenchus cocophilus op de jonge bladeren.