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# SYMPTOMATOLOGY, DISTRIBUTION AND INCIDENCE OF BASAL STEM ROT OF OIL PALM IN CÔTE D'IVOIRE

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**ABSTRACT**

The oil palm (*Elaeis guineensis* Jacq.) is a tree plant cultivated for its fruits, from which fatty substances are extracted for food and industrial uses. The oil palm sector has a positive impact on the socio-economic situation of producing countries such as Côte d'Ivoire. However, oil palm cultivation is subject to pests and pathologies, such as basal stem rot, which have been attacking Ivorian palm groves for several decade. This study was carried out to assess the spatial distribution and incidence of this pathology in the traditional oil palm cultivation area in Côte d'Ivoire. The method adopted for this study consisted of making an inventory of all the palm trees in a given plot, noting the presence or absence of symptoms of the disease and determining the incidence in each locality. The characteristic symptoms of the disease were observed: a pale appearance of the leaves, the arrows not open, the appearance of carpophore at the base of the stem or on root. Disease is present in the localities of Ehania, Eloka, Anguédédou, Boubo and Okroyo. But absent from the locality of Iboké. The incidence of the disease was between 0% Iboké and Ehania 1.15 %. This study establishes for the first time a summary map of the distribution of basal rot of the oil palm in Côte d'Ivoire.

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## INTRODUCTION

The oil palm (*Elaeis guineensis* Jacq.) is an important perennial crop cultivated in the humid intertropical zones of Africa, America and Southeast Asia (Reddy et al., 2019). It is grown for its palm oil and palm kernel oil, extracted respectively from the pulp and kernel of the fruit (Diabaté, 2008). The plant is important both economically and socially because of the income generated by its cultivation.

In Côte d'Ivoire, oil palm cultivation covers an area of 370,000 ha, with an annual production of crude palm oil around 500,000 tons per year (Bessou and Dubos, 2020). This production of crude palm oil positions the country as the fifth largest producer in the world after Malaysia, Indonesia, Thailand and Nigeria. Being the second biggest African producer, Côte d'Ivoire, consumes 45% of its palm oil production and exports have increased over the last five years at an average rate of 20 percent annually (USDA, 2022). On the strength of this situation, the country aims to increase its production in order to ensure its self-sufficiency in vegetable fats and to meet external needs. However, oil palm cultivation is highly threatened by insect pests and fungal pathogens such as basal stem rot.

First described in Congo in 1915, basal stem rot of oil palm has gradually spread to other oil palm growing areas (Turner and Bull, 1967). Since its introduction on a large scale in 1960, this pathological issue remains the most devastating in palm groves in Southeast Asia causing losses of up to 50% in palm mortality in plantations (Murphy et al., 2020). In recent decades, several oil palm trees in several industrial plantations in Côte d'Ivoire have shown symptoms similar to those described as basal stem rot, namely the appearance at the bottom of the stem of carpophores of basidiomycete fungi.

The present study was therefore, initiated in order to carry out the health monitoring of some plantations located in the traditional zone of oil palm cultivation in Côte d'Ivoire. Specifically, this study will address the symptomatology of basal stem rot, its distribution and its incidence in the localities of the traditional oil palm cultivation areas in Côte d'Ivoire.

## MATERIALS AND METHODS

### Prospecting areas

Surveys were carried out in 6 localities located in the south of Côte d'Ivoire. These areas were Ehania and Eloka located in the south-east, Anguédédou and Boubo located in the south-center and Okrouyo and Iboké located in the south-west. In each locality, one industrial plantation and three village plantations were identified (Table 1).

Table1: localities and areas covered by surveys.

| Site location | Industrial Plantations (PI) | | Village Plantations (PV) | |
|---|---|---|---|---|
| | Plantations in relation to the year of cultivation | Area (ha) | Plantations in relation to the year of cultivation | Area (ha) |
| Eloka 5°18' N ; 3°48' O | Palmafrique (1993) | 341,1 | Absent | 0 |
| Anguédédou 5°24' N ; 4°12' O | Palmafrique (1993) | 225 | PV Asse (2004)<br>PV Akré (2011)<br>PV Bancé (2010) | 38 |
| Boubo 5°50' N ; 5°22' O | Palmci (2000) | 750 | PV Kouamé (2000)<br>PV Traoré (2008)<br>PV Sanogo (2001) | 24 |
| Ehania 5°21' N ;3°00'O | Palmci (2002) | 350 | PV N'guessan (2009)<br>PV Traorer (2009)<br>PV Bamba (2008) | 08 |
| Okrouo 5°45' N ; 6°24'O | Sipefci (2008) | 329,53 | PV Bruto (1996)<br>PV Bruto (1996)<br>PV Bruto (1996) | 16,52 |
| Iboké 5°21' N ; 3°00' O | Palmci (2008) | 3784,68 | PV Bruto (1996)<br>PV Bruto (1996)<br>PV Bruto (1996 | 70 |

### Health monitoring of palm groves

Plant health monitoring was carried out in 2020 and 2021, twice a year. During monitoring, each oil palm was observed from the root plate to the plant crown. The identification of affected palms was based on the most characteristic symptom like the presence of fruiting bodies of the fungus (carpophore) on the stem of the oil palm. All the oil palms of a plantation were observed and the observations were recorded according to the position of the palm.

### Incidence of basal palm stem rot in the surveyed areas

Sanitary monitoring of the study areas made it possible to count the palm trees affected by basal stem rot for each plot. The incidence was determined by using the proposed formula by Edy et al. (2020).

Disease incidence (DI%) $= \frac{NPI}{NTPC} \times 100$

DI: Disease incidence

NIP: Number of infected palms

NTCP: Total number of cultivated palms

**Data analysis**

The data were collected and recorded with the Excel spreadsheet (2007) before being subjected to an analysis of variance (ANOVA) using the Statistica 7.1 software. For recording the incidence, data from two surveyed years were taken. In the case of a significant difference ($p<0.05$), Fischer's least significant difference (LSD) test was used to identify homogeneous groups. QGIS software version 3.14 was used to make the disease distribution map.

**RESULTS**

**Symptoms of basal stem rot in palm groves**

During sanitary monitoring of some palm groves in a few localities in Côte d'Ivoire, infected palms showed foliar symptoms such as pale leaf canopy and unopened spire leaves (Figure 1A). Desiccated dead lower leaves fell off at the point of attachment to the trunk or broken at some point along the rachis and hung down to form a skirt of dead leaves (Figure 1B). In addition to the observed leaf symptoms, there was also the creation of barrels at the base of the stipe (Figure 1C). Largely, rotted oil palms broken at the base and collapsed leaving diseased stipe tissue in the soil (Figure 1D). There were also fruiting bodies of the pathogen with a lacquered surface and a whitish border at the base of the stipe and in the roots (Figure 1E). The color of the upper surface ranged from light to dark brown with a smooth or rough margin and a glossy lacquer finish. The lower surface is whitish and had many small pores. Cross-section of the stipe showed lesions, marked by light brown areas of tissue, and by irregular darker areas (Figure 1F). The diseased palms were scattered or clustered in clumps in the plots.

Figure1: Internal and external symptoms of basal stem rot. A) Pale leaf canopy and unopened arrowhead leaves; B) a skirt of dead leaves; C) collapsed tree showing fruiting bodies; D) sporophores developed at the base of the stipe; E) damage to light brown areas of tissue; F) and lesions marks of tissue

**Distribution and incidence of basal stem rot in the traditional oil palm growing areas of Côte d'Ivoire**

Basal rot of the oil palm trunk was observed in all the surveyed localities, except Iboké as shown in Figure 2. Analysis of the collected data indicated a significant difference between the incidence rates of BSR in the different surveyed localities. The average incidence was the highest in the locality of Ehania (1, 15 %). Moreover, the disease was not observed in the locality of Iboké (Figure 3).

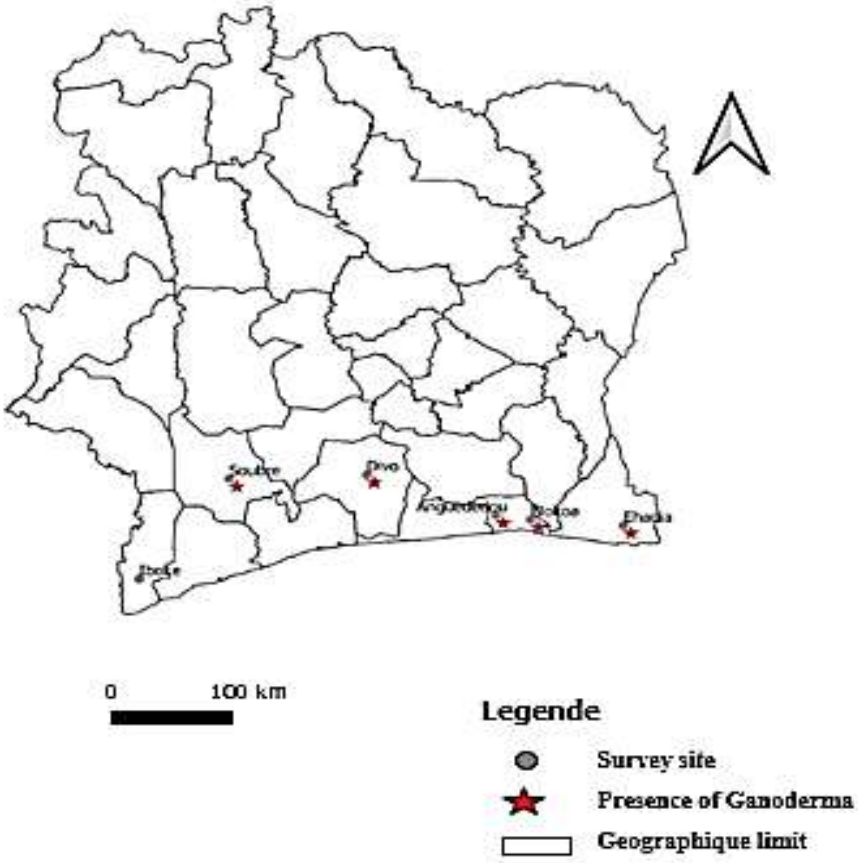


Figure 2: Area of distribution of oil palm basal stem rot in southern Côte d'Ivoire.

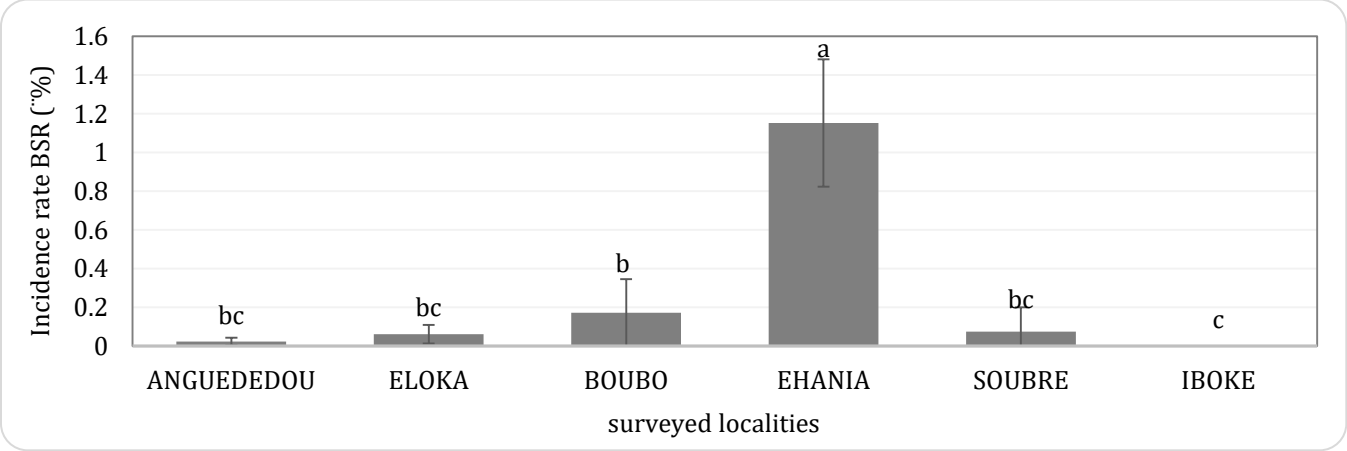


Figure 3: Incidence of basal stem rot (BRS) of oil palm in the localities surveyed according to the plantations monitored.

## DISCUSSION

Phytosanitary surveys revealed the presence of basal rot of the oil palm stem in almost all the visited areas with the exception of Iboke. The symptoms observed on the leaves and stipe showed on the one hand the same characteristics as those described for the pathology in South Asian and African countries (Priwiratama et al., 2020). Indeed, symptoms observed during the surveys included a pale appearance of the leaves, unopened spires, dead leaves hanging at the point of attachment to the trunk or breaking at some point of the rachis to form a skirt with the presence of the carpophore. In addition, plants without leaf symptoms showed holes at the base of the stipe and carpophores which would seem to be different from those described elsewhere on diseased palms. The presence of carpophores is the main characteristic of basal stem rot of oil palm (Wahab, 2016). Infected palms are grouped together or scattered randomly in the palm groves. The observation of infected palms scattered randomly in palm groves could be justified by cultural methods. Indeed, during the realization of the cultivation operations, the tools used could facilitate the contamination of other palm plants by the dissemination of the primary inoculum in the plantation. For grouped infected palms, this distribution suggests a common origin from a single inoculum.

Indeed, the first infected foot could easily transmit the disease to the other feet located in the vicinity via secondary roots. These results are similar to those shown by Priwiratama et al., (2020).

In the localities where the pathogen was observed, its incidence varied from one site to another. These observations could be related to the presence of different strains of the pathogen with varying levels of aggressiveness. Indeed, several species of *Ganoderma* have been reported as being responsible for PBS at varying levels of aggressiveness (Singh, 1991).

In addition, the infection was at the primary stage and given the low incidence rate. The results are in agreement with the observations of Susanto who affirmed that the basal stem rot would spread slowly in the palm plantations from 1% to 2% in the young cultures aged 10 to 12 years and can undergo a 25% increase after the 25 years old (Susanto, 2012). Moreover, the mode of transmission of the pathogen which would be by root contact would imply the slow development of the disease due to the duration of contact of the roots with the inoculum.

## CONCLUSION

At the end of this study, it appeared that the basal rot of the oil palm stem is present on almost all the surveyed sites with the exception of IBOKE. Infected palms showed new symptoms of basal stem rot. The incidence of the disease indicated a primary infection of the disease which should be monitored very closely in order to more effectively control the spread of the disease. For effective management of the disease, it would be useful to study the taxonomic and genetic diversity within fungal populations across the extent of the oil palm production area.

## AUTHORS' CONTRIBUTIONS

CIA, KKABM and DS designed the study, CIA and KKABM executed the experimental work, collected data, CIA and KKABM analyzed the data, CIA wrote the manuscript, KM, KKABM and DS assisted in writing the manuscript, KM and DS proofread the manuscript.

## CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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