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ORIGINAL PAPER

Leaf Spot Disease of Shea Nut Tree (*Vitellaria paradoxa*): A review on Epidemiology, Impacts, and Management Options

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ABSTRACT

The sheanut tree *Vitellaria paradoxa* is an indigenous tree crop grown in the savannah forests of West Africa. Almost every part of the plant has an economic or medicinal purpose to most rural and urban fraternities where this tree grows. Despite the immense relevance of the plant to society, limited studies are delving into the various challenges that limit its productivity, even though it is challenged significantly. Regardless of the shea tree seen as resistant to various biotic and abiotic stresses. One of the main challenges related to its growth and development is the incidence of diseases. Even though studies relating to this topic are limited, results from the various studies revealed that the leaf spot disease, associated with *Fusarium moniliforme*, *Pestalotia guepini, and Phoma sorghina* is one of the most important yield-limiting factors of the shea tree. It affects the tree crop at any stage of growth. As a foliar disease, it causes lesions on the leaves, reducing the surface area of leaves, and hence affecting the photosynthetic ability of the plants, transcending directly on the overall yield. As important as this disease can be to the shea nut production value chain in Ghana, not many studies have focused on the disease and its management. This review seeks to provide an overview of the epidemiology, impacts, and status of the disease. drawing references from existing literature.

Keywords: *Vitellaria paradoxa*, leaf spot disease, Shea nut tree, *Pestalotia guepini, and Phoma sorghina*.

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Introduction

The shea tree *Vitellaria paradoxa* is an indigenous tree crop species across the Guinea savannah ecological zone of West Africa. In as much as not many people have yet invested in its commercial production, it is estimated to occupy a land area of one million km^2 of savannah forests in some African countries such as Ghana, Nigeria, Burkina Faso, Senegal, and western north of Uganda (Salle *et al.*, 1991). Even though current data does not suggest the exact area of production, it has been estimated in recent times to have increased significantly in production due to its high demand in both the local and international markets (Agúndez *et. al.*, 2020). The existence of *Vitellaria paradoxa* in the African region can be said to be wild and widely diversified. This diversification can be estimated both in their genetic composition and phenotypic orientation. This diversification, combined with other constraints such as the incidence of diseases and pests, according to reports, has been responsible for an unpredictable yield actualization for the crop over the years in the region (Fontaine *et al.*, 2004 and Lovett and Haq, 2000). In Ghana, for example, the shea tree is predominantly found in the Savannah, Northern, Northeast, Upper East, and Upper West regions, with an estimated population of about 9.5 million, distributed randomly in the wilds and forests (Abbiw,

1990 and Quainoo *et al.*, 2012). According to Hall *et al.* (1996), about 8,000 tons of shea nuts are collected annually across the region. During its season of fruiting (usually between June and August), the fresh pulp component of the fruit, full of various essential dietary nutrients serves as food for many people during its season, contributing significantly to food and nutrient security among both rural and peri-urban folks. According to Amegah *et al.* (2019), it has been reported in Ghana to be efficient in lowering blood pressure. Most importantly, the nuts play a very important socio-economic role across most rural and smallholder farmer communities across production areas.After processing the nuts, the fat extracted serves various purposes for both rural and urban folks and serves as critical industrial raw materials manufacturing companies. For example, it is used domestically by many households as cooking oil. In the manufacturing industries, it is used as an important main raw material for commercial products such as soap, ointment, waterproof house walls, as well as other cosmetics. Furthermore, its roots, backs, and leaves are said to have wonderful medicinal properties, whilst the main trunk serves as a source of materials for farm tool handles and wood for other domestic and commercial purposes. According to Anon. (2008), Ghana has been responsible for about 60 % of shea nuts exported by Africa in 1998. As sure as this could undoubtedly be varied over the years, there is no evidence stating the actual variation.

Contrasting the numerous importance of shea, its production is constrained by many challenges. Notable among them is the incidence of pests and diseases (Dwomoh, 2003; Dwomoh *et al.*, 2004 and Soro *et al.*, 2011). For example, in Ghana and Burkina Faso, one of the oldest and most critical diseases reported to have affected the shea tree is the leaf spot disease which was associated with *Botryodiplodia* (*Lasiodiplodia*), *Fusarium moniliforme*, *Pestalotia guepini* and *Phoma sorghina* (Dakwa, 1986 and Semde *et.al.*, 2022). As alarming as the impact of this disease can be on food security and other health and industrial outputs, less attention has been paid to the diseases in contemporary studies. This review seeks to consolidate all appropriate studies on the status of the disease, emphasizing the epidemiology, impact, and management options.

Etiology and Epidemiology of Leaf spot of Shea Crop :

In as much as the disease is predominantly seen on the leaves, it can also be seen on almost all above-ground parts of the tree at the seedling stage: from leaves to petioles and stems of both young and older trees. Symptoms are usually seen as lesions on the affected parts of the plant. In most instances, lesion sizes are highly dependent on the disease severity, which is greatly influenced by other environmental conditions such as warm temperature and high humidity, the presence of an alternative host, etc. Lesion size could be seen as a pinhead in less severe infections whereas can be seen as widespread patches or severely blighted leaves. Also, lesions are seen in a reddish-wine spot, which could later be surrounded by a hollow band on concentric rings and sometimes accompanied by a wide-water-soaked pale band. This water-soaked-pale band in most instances represents the active growing point of the lesion. In usual instances, lesion distribution does not follow any particular pattern. Nevertheless, lesions could be found traversing the ribs on the lamina, with the exception of the Marib, mostly appearing on the abaxial leaf surface of the *V. paradoxa* (Dakwa, 1986; Akrofi and Amoah, 2009). The disease is known to be very severe in the lower leaves of younger plants as compared to the upper leaves. This could be due to the fact that the pathogens overwinter in infected crop debris on and in the soil.

Impacts of Pestilotia and Phoma leaf spots:

As with many other fungi foliar diseases, the pestilential leaf spot causes infection and leads to various forms of losses in shea production. For example, in an Akrofi and Amoah (2009) study, there

was a significant yield reduction in yield on most young disease-infected shea trees. In addition, these young trees also suffered the highest fatal levels due to the disease during their study. The negative impact of the disease on yield could be due to the fact that leaf spot disease reduced the number of leaves, or the surface area of leaves, reducing the photosynthetic capacity of the related trees. In expense, this means that severely infected leaves contribute little to nothing to the overall chlorophyll production of the plant, which could translate to a poor contribution to the general development and production of the tree as observed by (Akrofi and Amoah, 2009). Other studies have also revealed that the quantity and quality of shea fruit yield have a positive relationship with the number of leaves of the crop (Sanou *et al.*, 2006). This strongly suggests that the rampant incidence of the disease, coupled with an un-attending attitude of stakeholders across various production areas could be the hidden yield-reducing constraint across the area over many years now, yet going unnoticed. From this, one could suggest that a rapt management approach to the disease will bring forth a significant increase in the achievable nut yield of shea. However, no present study has recommended any effective management strategy to combat the disease on a large scale and commercial purposes.

Management Strategies:

In the current stunt, less attention is paid to the disease in terms of management. Perhaps, this could be because most of the shea trees grow in the wild and have not been internationally cultivated, until most recent times. However, findings from a few studies suggest that the use of resistant varieties can be a breakthrough in the management of the disease (Akrofi and Amoah, 2009 and Semde *et al.,* 2022). To this, the study further revealed that there are variations in the incidence and severity of the disease across their geographical study areas. This could closely be linked to, among other factors the genetic differences among shea trees across the study sites. In agreement with this, previous studies have also revealed a genotypic and phenotypic variation among various shea trees across the African region (Fontaine *et al.,* 2004 and Lovett and Haq, 2000).

Fig.1: Symptoms of leafspot diseases in shea crop (Semde *et al*., 2022)

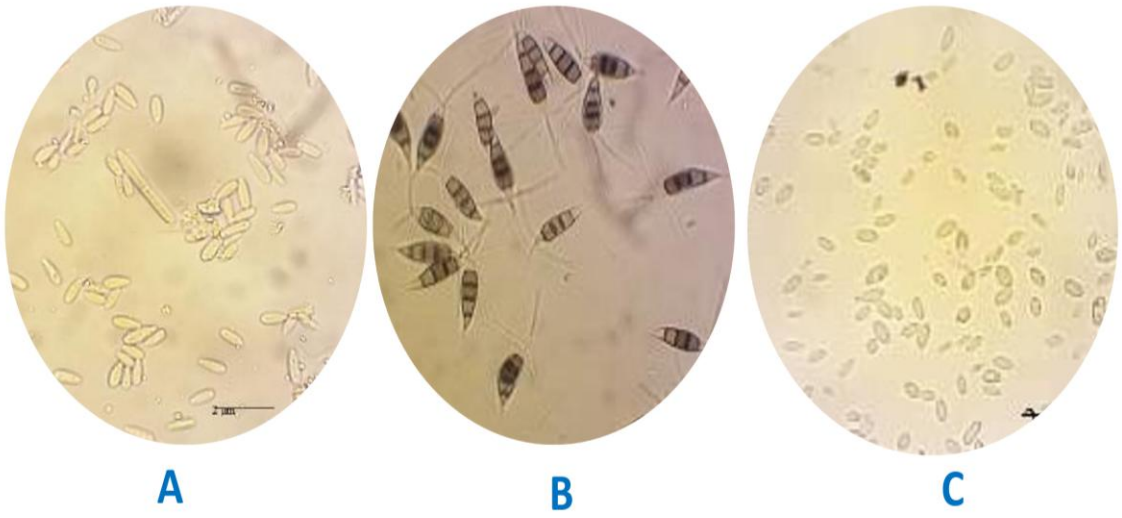

Fig. 2: Microscopic characteristics of *Fusarium moniliforme* (A), *Pestalotia guepini* (B) and *Phoma sorghina* (C) conidia observed on shea tree leaves at Komki Ipala (X40) (Semde *et al.*, 2022).

For example, from thirteen locations across eight countries, sixty-seven polymorphic and fifteen monomorphic RAPD loci were detected in one hundred and seventy-nine individuals (Fontaine *et al.*, 2004). To this finding, one can safely suggest that in current states where various investments are made to improve the growth and development of shea, a careful choosing of planting materials for grafting and other initiatives could lead to a breakthrough in the management of the disease. Also, it is recommended to pay attention to shrubs and other trees that may serve as alternative hosts for the associated causal organisms. For example, in the findings of Akrofi and Amoah (2009), they identified that *Dalegia Oliveri* Hutch, *Nauclea latifolia* Smith, Caesalpiniaceae, Dalz, and N. *latifolia* found within the vicinity of the study area were also infected by the disease, suggesting their potential of hosting the pathogen, and potentially increasing the incidence and severity of the disease among nearby shea orchards.

CONCLUSION AND FUTURE PERSPECTIVES

The leaf spot disease of shea is associated with *Fusarium moniliforme, Pestalotia guepini, and Phoma sorghina* infection. Other shrubs and trees such as *N. latifolia* and *D. oliveri* could serve as alternative hosts, facilitating the prolific propagation of the pathogen. The impact of the disease could be immense in unmanaged cases. Despite the threatening impact of the disease, no clearly outlined measures have been laid or proposed for the effective management of the disease. Regardless, literature suggests that a careful selection of varieties and planting materials, accompanied by proper field management approaches, such as the elimination of alternative hosts could be a breakthrough in the management of the disease. Future studies focused on the various sources of primary inoculum, and how the pathogen is dispersed among true and alternative hosts can also contribute significantly to the efficacy of the management approaches. Also, molecular-based resistance of the existing varieties of other wild species can be exploited.

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