Journal of Research in Forestry, Wildlife & Environment Vol. 15(2) June, 2023
E-mail: *jrfwe2019@gmail.com; jfewr@yahoo.com*
http://www.ajol.info/index.php/jrfwe

ISBN: 2141 – 1778
Oladigbolu, et al., 2023

POST-HARVEST MENACE OF *Lasiodiplodia theobromae* ON KOLA NUT (*Cola* spp.) IN NIGERIA

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ABSTRACT

Kola nut is the fruit of a perennial plant called cola that belong to the family of Malvaceae. It is a lowland tropical crop fruit produced from September to January and June to July. Harvesting is done by plucking ripe pod from the trees with the aid of go-to-hell. Disease incidence during storage is a major post-harvest problem that farmers and Kola nut traders seek to solve. The major post-harvest pathogens in West Africa for the nut are Lasiodiplodia theobromae and it is considered a serious problem in agriculture since it causes a fast spread of the disease due to its wide range of unspecialized hosts.The problem posed by L. theobromae in storage is detrimental to the little production often achieved by kolanut farmers. Biological control using natural plant products presents a viable alternative in controlling plant diseases. The use of plants bio-extracts and organic control to reduce disease incidence of Kola nut storage disease would be seen as a practical solution to the problem encountered by kola farmers and traders during storage of nuts.

Keywords: Kola nut, *Lasiodiplodia theobromae*, Post-harvest, Disease

Correct Citation of this Publication
Oladigbolu, Y. O., Ayanwole, S. A., Orisajo, S. B., Ogundeji, B. A. Adesina M. W. and Oloyede, E. O. (2023). Aboveground biomass Allometric models for a private semi-natural forest in Aigeria *Journal of Research in Forestry, Wildlife & Environment* Vol. 15(2): 181 – 186.

INTRODUCTION

Kola nut as a crop of economic importance

Kola nut is the fruit of a perennial plant called cola that belong to the family of *Malvaceae*. The *Kola*species are trees native to the tropical rainforests of Africa. They belong to the cacao family. In 2003, following the angiosperm phylogeny, it changed its place from *Sterculiacea* to *Malvaceae* (Veronique, 2016).

Kola nut is a lowland tropical crop that grows well between latitude 6ºNorth and South of the equator. It grows best in regions with an annual rainfall ranging between 1,250-1,750cm. The most suitable soil for Kola nut cultivation is a well-drained fertile soil that is rich in humus (Uguru, 2011). In the forest areas of West Africa, kola is perhaps second to palm oil in importance in the list of indigenous cash crops.

However, about 40 species of kola have been described in West Africa. Out of the 40 species, only two (*Colaacuminata and C.nitida*) are important economic crops in the forest area of West Africa and the Caribbean Island (Ndagi*et al*, 2012). *Colanitida* was originally distributed along the west coast of Africa- from Sierra Leone to the Republic of Benin, with the highest frequency and variability occurring in the forest areas of Côte d'Ivoire and Ghana. It is also stated that cultivation of *C. nitida* was carried eastwards through Nigeria towards Cameroon and the Congo around 1900 and spread westwards as far as Senegal. It has also been cultivated in Angola

and Tanzania. Kola has therefore been extensively cultivated in tropical South and Central America and the West Indies (Opeke, 1992).

Nigerian Kola nut production accounts for about 70% of world's Kola nut with an annual estimate of 200,000 metric tons of fresh nuts, mostly from South West Nigeria (CBN, 2002). The major production States are Ogun, Abia, Anambra, Ebonyi, Enugu and Imo States. Ogun State produces the largest amount of Kola nut in the country, devoting about 65,000 hectares of land and producing 80,000 MT of the crop in 2010/2011(NSAEC, 2013).

Traditional Post-Harvest Handling of Kola nut in Nigeria

Harvesting of Kola nut in kola growing areas is normally done by plucking ripe pod from the trees with the aid of *go-to-hell*, which is usually tied to a long bamboo stick. The farmers also pick the pods that naturally fall to the ground. The processing of *C. acuminata* starts by careful examination and sorting out pods infested with diseases and other deformities from the healthy pods. The seed coat or testa of the nuts from these healthy pods are removed by soaking the nuts in clean water for 24hours to enhance rottening, after which the nuts are skinned and rinsed in fresh water. The rinsed nuts are collected in wide flat baskets through which excess water drains off before they are kept inside the room where they are maintained under ambient room temperature for a period of three days to cure. Defective/infested nuts are picked out during this curing process that usually involves considerable sweating to reduce the moisture content of the nuts (Asogwa *et al*., 2011).

The nuts are then graded into sizes for proper storage in big sized baskets. The storage baskets are first lined up with thin transparent nylon sheet followed by a layer of *Newbouldia laevis* (Hup Plum Leaf) leaves placed with the ventral (upper) surface facing downwards in the basket thereby exposing the dorsal (back) surface of the leaves to the nuts. The nuts are carefully placed inside, layer by layer and after each layer *Parkia biglobosa* (African Locust bean leaf) leaves are spread out evenly on top of the nuts. *Newbouldia laevis* leaves are used to cover up the last layer of the nuts, before finally sealing up the whole thing with the first layer of polythene sheet. The baskets are then stored under normal room temperature and relative humidity. The *N. laevis* leaves and the polythene sheets keep the nuts in an air tight condition and prevent desiccation of the nuts, while the *P. biglobosa* leaves was believed to brighten the nuts, thereby giving them a bright coloration which makes them attractive. This cultural method of sorting out deformed and infested nuts during storage ensures maintenance of whole nuts and reduces or eliminates completely, chemical usage in storage. The deformed and infested nuts are sometimes processed and sold out immediately, while the wholesome nuts are stored for over 14 months provided processing and handling are carried out with care (Asogwa *et al*., 2011).

Pests and Diseases of stored Kola nut in Nigeria

Disease incidence on Kola nutduring storage is a major post-harvest problem that farmers and Kola nut traders seek to solve. The major post-harvest pathogens in West Africa for the nut are *Lasiodiplodia theobromae* and *Fusarium pallidoroseum* (Agbeniyi, 2004). *Lasiodiplodia theobromae*is a ubiquitous pathogen of tropical woody trees reported to cause shoot blight and dieback of many plant species including black branch and dieback disease of cashew. It has also been reported to cause gummosis of *Jatropha podagrica* (Fu *et al*., 2007). *Fusarium pallidoroseum* has also been implicated as causative pathogen of brown rot disease of Kola nuts.

Presently, the only control strategy practiced by farmers is to remove diseased nut at intervals during the storage period. The major post-harvest insect pests include *Balanogastris kolae*, *Sophrorhinus spp*, *Characomasticti grapta, Phosphorous virescens* etc. Among these pests, the kola weevils *Balanogastris kolae* and *Sophrorhinus* spp happen to be the most serious pests of kola in Nigeria. They are referred to as "field – to – store" pests as their infestation is initiated in the field and persists in storage (Asogwa *et al*., 2006).

***Lasiodiplodia theobromae* as kola nut storage pathogen of economics importance**

Lasiodioplodia theobromae is a cosmopolitan fungus that is polyphagous and widespread unspecialized virulent rot pathogen. This fungus is generally regarded as a weak pathogen that invades stressed or wounded plants after drought, wind, insect damage and after human damage as a consequence of cultural practices. The fungus is distributed in the tropics and subtropics, it has variety of host plants ranging from tree crops like kola, cocoa, to vegetables and fruits like passion fruit, avocado, orange, mango and cherry. It is associated with different symptoms such as shoot blights, stem rot, cankers, fruit rots, die-back, gummosis, collar and root rot, lesions in cuttings, leaves and seeds, death of seedlings and fruit rot in some fruit trees (Sutton, 1980).

The infection of kola by *L. theobromae* is considered a serious problem in agriculture, since it causes a fast spread of the disease due to its wide range of unspecialized hosts. *Lasiodiplodia theobromae* has also been frequently isolated as endophytic in the leaves of many plants. Itsdamage could lead to post-harvest storage rots in trees, fruits and vegetables which cause serious economic losses worldwide (Freire and Bezerra, 2001)

Agbeniyi and Fawole (1999), reported that one of the major post-harvest problems of Kola nut has been storage rot caused by *L. theobromae.* Infected nuts decay rapidly, although there is little secondary spread, the surrounding nuts are covered with masses of fungal spores. This contamination of healthy nuts with spores from rotted nuts is termed "soilage" and it is often a greater economic problem than that of decayed nuts in areas where the fresh market produce is cultivated. Severe outbreaks of storage rot of up to 50% per tonne due to storage rot may be recorded. These outbreaks may result in a reduced storage life and lower market sales (Oludemokun, 1983). Therefore, Since no fungicides are recommended for post-harvest use on Kola nuts in Africa, alternative options that is safe for human consumption and management of the diseases need to be evaluated for their ability to prevent or reduce *L. theobromae* on Kola nut in storage.

Management of *L. theobromae* induced kola storage rot

The problems posed by diseases of Kola nut in storage are detrimental to the little production often achieved by Kola nut farmers. Kola nut traders often use chemicals like Chlordane to preserve their product, to reduce infestation of diseases. *Aikpokpodion et al.* (2013), reported that Chlordane residue was detected in all the Kola nut samples obtained from Oyo, Osun and Ogun State at varying concentration.

Chlordane is an organochlorinecyclodiene pesticide derived from hexachloropentane.It forms an adduct with cyclopentadiene and chlorination of the adduct gives two isomers, alpha and beta. The mixture is called chlordane. Chlordane was banned because people may be exposed to its hazard by eating food contaminated with chlordane. Laboratory mice that were fed with chlordane over long period of time had higher incidence of liver cancer than untreated mice (ATSDR 1997). Exposure to Chlordane metabolites may be associated with testicular cancer. The incidence of seminoma in men with the highest blood level of Chlordane was almost double of that of men with the lowest level. Postrate cancer has been associated with transnonachlor levels, a component of Chlordane (McGlynn, *et al.*, 2008).

Olorunmota *et al.*(2021)also reported that high percentage (88.3%) of Kola nut traders used Phostoxin *(aluminium phosphide)* in controlling Kola nut storage diseases, while 2.5% and 1.7% employed the use of botanical method and Integrated Pest Management (IPM) respectively. The high use of chemicals among the traders is of great concern as the nuts are mostly consumed raw, though the chemicals used are recommended but it was discovered that 100% of Kola nut traders that use chemicals in controlling pest and diseases purchased them from hawkers in the market .This increase the dangers associated with pesticides as expired or fake products (which are very hazardous to human health) may be sold to traders with low level of education.

Future prospects for safer control of *L. Theobromae* induced storage disease of kola nuts in Nigeria

Presently, the most commonly known safe control strategy of Kola nut practiced by farmers is to remove diseased nuts at intervals during the storage period. The use of chemical fungicides is not desirable due to the health hazard it constitutes to the consumers. Biological control using natural plant products presents a viable alternative in controlling plant diseases. The search for bioactive compounds from medicinal plants, and other angiosperms for biological control are crucial for the survival of Kola nut in storage. There is need to include Integrated Diseases Management in the control of *L. theobromae* on Kola nut in storage.

The use of plants bio-extracts for the control of Kola nut storage disease would be seen as a practical solution to the problem encountered by kola farmers and traders during storage of nuts. Also, it would be seen as a positive response to public concerns about the adverse effects of the use of pesticides on human health and on the environment. The work of Agbeniyi *et al.(*2013) opened up a safer alternative on the control of *L. theobromae* who justified the efficacy of leaf extracts of five plant species namely: *Glyricidia sepium* (Jacq.) Linn, *Tectona grandis* Linn. *Ocimum gratissimum* Linn., *Anacardium occidentales* Linn. and *Carica papaya* Linn. against storage fungi *Lasiodioplodia theobromae* and *Fusarium pallidoroseum.* The potency of these leaf extracts after storage at ambient temperature for 15 and 30 days, respectively was also tested on the radial growth of *L. theobromae* and *F. pallidoroseum*. The results indicate that leaf extracts from *O. gratissimum* and *A. occidentales* are effective in inhibiting the radial growth of *L. theobromae* and *F. pallidoroseum,* respectively. *O. gratissimum* even at 2.5% concentration gave 35.89% mycelial growth inhibition of *L. theobromae*and 10% concentration gave 50.3% mycelial growth inhibition after five days. The extract of *C. papaya* exhibited less antifungal activity than either *O. gratissimum*or *A. occidentales.* Generally, with the exception of *C. papaya* leaf extract, there was no significant difference (P = 0.05) between the fresh leaf extract and the stored extracts in the inhibition of the mycelial growth of either *L. theobromae*or *F. pallidoroseum and the* potency of the leaf extracts was retained even after 30 days of storage at ambient temperature.

Also, there is little knowledge on the use of organic control on *L. theobromae.* Maria das Graças *et al.*(2013) reported that castor bean oil at a concentration of 7.5 $mgmL^{-1}$ reduced the mycelial growth of *L. theobromae* by 36.36% in coconut. The effect was only fungistatic, as only a delay in mycelial growth was observed. However, residual effect of castor bean oil confer about 40% reduction of germination on the fungal spores. Mycelial growth of *L. theobromae* is reduced by palmitic acid (1.2%, w/v) and ricinoleic acid (87.5%, w/v) added into the culture media. Finally, results suggest that the effect of castor bean oil on spore germination inhibits mycelial growth both *in vivo* and *in vitro*, which may be attributable to palmitic and ricinoleic acid constituents of the oil. Thus, we could use castor bean oil in the control of *L.theobromae* on Kola nut in storage. Agyeman-Boateng (2016) explained the fungicidal attributes of *Plectranthus colerides* on vegetative growth, sporulation and pycnidial formation of *L. theobromae* when its aqueous extracts were used at higher concentrations. More research work is needed on various plants extracts and their combinations to ascertain their efficacies and thus, provide a wider range of choices to farmers in controlling the damaging effects of *L. theobromae* on Kola nut.

CONCLUSION

Kola nut rot caused by *L.theobromae* is an economic disease that requires multifaceted approach in preserving the commodity (Kola nut) and making them safe for consumption. Handling of Kola nut during harvest needs to be monitored to prevent damage to nut which may predispose them to diseases during storage. Integrated management strategies of *L. theobromae* that takes into cognizance available safe options, will reduce economic losses thereby making healthy and safe Kola nuts available to consumers.

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