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Strategies for Improving Production and Storage of Kolanuts in Nigeria

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Abstract: Kola is the second most important indigenous cash crop in Nigeria. It is estimated that the country currently produces 70% of world's kolanuts with an annual production of 200,000 metric tones of fresh nuts. Kolanut and kola by-products are noted for many industrial and domestic uses thereby contributing immensely to local and foreign exchange earning of the country. Despite the importance of this crop, many constraints militate against the good management of large kola plantations as well as getting commensurate returns from these plantations. Notable among these problems are: incompatibility among trees, partial and total sterility, inefficient natural pollination, neglect of farms, decline in soil fertility and old age of most kola trees in existence, coupled with both field and storage pests and diseases. These constraints are however not without solutions as research activities at the Cocoa Research Institute of Nigeria (CRIN), Ibadan have evolved strategies for improving production and storage of kolanut in Nigeria. This paper hereby highlights various research breakthroughs aimed at improving production and storage of kolanut in Nigeria.

Key words: Kolanut · Production · Constraint · Improvement · Storage

INTRODUCTION

In the forest areas of West Africa, kola is perhaps second in importance only to the oil palm in the list of indigenous cash crops. The cultivation of kola in Nigeria began in the 19th century [1] and it is estimated that the country currently produces 70% of world's kolanuts with an annual production of 200,000 metric tones of fresh nuts, mostly from the South West Nigeria, which accounts for about 88% of the produce [2-6].

Kolanut (*Cola acuminate* also known as *abata* and *Cola nitida called gbanja or goro*) contain caffeine (2 to 3%) and smaller amounts of theobromin and kolanin, which dispel sleep, thirst and hunger and act as a stimulant and anti-depressant. They are also thought to reduce fatigue, aid digestion and work as an aphrodisiac [7]. The nuts are nutritious, containing nearly 1% protein, 1.35% fats and 45% starch [8]. More recently, kolanuts and kolanut extracts have become popular in Europe and North America as a natural or alternative medicine. It also has industrial usage for the production of drugs, soft drinks, wines, candies, beverages, animal feed formulation, liquid soap and dyes [9-22].

Due to expected increase in the domestic chewing market for kola, increase in demand for exported nuts to meet the expansion of sales of "cola" beverages and other products containing kolanuts and the expected demand for the by-products, following the recent discoveries of their potential industrial uses, the market prospects for kola are very good. But unfortunately, the production remains low because of many constraints. This presentation identifies the need to re-direct production efforts to meet the expected increases in demand and elaborates on the strategies for improving the production of kolanuts in Nigeria.

Constraints of Kola Production: The Cocoa Research Institute of Nigeria (CRIN) in an effort to sustain the production of kolanut to meet the increasing demand; have identified the major agronomic factors that limit the yield of kola. These factors include; very low yield due to old age of trees, self and cross incompatibility among trees, partial and total sterility, inefficient natural pollination, field and storage pests and diseases.

Variability in Kola: Kola exhibits tremendous amount of variability in the number of trees that bear fruit such that in a given kola plot the percentage of trees that bear fruits varies from year to year. There is variation in production from tree to tree and from year to year on a given tree, which occurs even among ramets (rooted cuttings). Auto incompatibility and varying degrees of cross

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incompatibility also exist in kola. While some trees are cross incompatible, it is known that 70-90% of kola trees in Nigeria are self-incompatible. When trees of the same incompatible group are planted together in the same plot the yield of the plot is highly reduced. Okoloko and Jacob [23] identified incompatibility as one of the major factors limiting the yield of kola grooves in Nigeria. The extreme variability in yield of kola grooves is also attributed to the widespread occurrence of self and cross incompatibilities.

Interspecific Hybrids: The present generation of Nigerian kola was established largely from seedlings of interspecific hybrids; since the Nigerian farmer in selection of seed for planting paid no scrupulous attention. When *C. nitida* is cross pollinated with *C. acuminata* or vice versa, the nuts derived look exactly like the female parents in the cross; but when sown they often give rise to sterile trees [3]. The widespread interplanting of both *C. nitida* and *C. acuminata* in Nigerian kola groves over the years is believed to have given rise to a high level of unproductivity, where 75% of the fruits are produced from only 25% of the trees. The result is that the national average production is as low as 250 fresh nuts per tree per hectare.

Delay in Flower Initiation: Characteristically the kola tree takes a long time to come to bearing. Flowering in *Cola nitida* seedlings may take between 3 to 7 years and may take a much longer time in *C. acuminata*, but is much shorter in rooted cuttings.

Pollination in Kola: Kola is by nature self-sterile. A kola tree may remain unproductive except it is pollinated through mechanical agencies such as man, animal or insect pest. Though kola trees are prolific in flowering, the natural pollination is known to be inefficient and only few fruits develop on the kola trees. There is also additional problems of irregularity in flower production, flower drop, short pollen viability period and fruit abortion.

Long Juvenile Periods: The kola tree is known to display a long juvenile period sometimes lasting up to 10 years. This is quite discouraging as farmers expect returns as early as possible.

Pest Problems: The role of insect pests, which are capable of destroying more than half of the little produced, cannot be overemphasized [11]. These pest complexes were classified into major and minor pests depending on their damage patterns. The major pests of kola are the weevils (*Balanogastris kolae*, Desbr. and *Sophrorhinus* spp); the stem borer (*Phosphorus virescens* Olivier); the fruit fly (*Ceratitis colae* Silv); the pod borer (*Characoma stictigrapta* Hmps); the leaf roller (*Sylepta* spp) and the defoliator (*Anomis leona* Schuas) [24]. The kola weevils *B. kolae* and *S.* spp are the most destructive insect pest of kolanuts. They are field-to-store pests. All trees in Africa are believed to be infested and the percentage infestation ranges from 30-100% [25].

Disease Problems: Many fungal diseases affect kola tree but the major ones, which pose serious threat to the production of the crop, are the root rot diseases caused by *Armillaria mellea* and *Formes noxius*. Others include complexes of fungi attacking fresh and stored nuts.

Diseases of Fresh Kolanuts: This can be classified into three; internal rots, fresh rot and dry rot. Internal rot is caused by *Fusarium solani*. The cotyledons of infected kolanuts have an internally characteristic of grey rot while the outer surfaces look healthy. The causal agent for the fresh rot is *Fusarium moniliforme.* At incipient of infection, colonies of fungal hyphae develop on the testa of the kolanuts followed by development of yellow patches on the older lesions. It affects both harvested and unharvested nuts. Dry rot, which is caused by *Furarium solani* is characterized by the development of grayish powdery crusts on the kolanut cotyledons. The affected areas eventually turn black and hard. Infection often starts from the outside and spreads inwards. Dry rot is a field-to-store disease affecting the fresh harvested kolanuts and stored nuts.

Diseases of Stored Kolanuts: The diseases of stored nuts are the dry rot, grey mould and black rot. Their causal agents are *Fusarium solani, Boytritis sp* and *Botryodiplodia theobromae* respectively. Grey mould is a serious disease of stored kolanuts, which spreads very rapidly from nut to nut. The kolanuts are covered with lesions having grayish and powdery mycelia. The black rot is characterized by a brownish black incrustation, which appear in the form of spots over the outer surface of the nut, causing the infected portions to turn charcoal black and hard.

Strategies for Improvement of Kolanut Production: New technologies and high yielding plant materials have been developed to reduce the genetic, agronomic and pest

problems of kola. More industrial uses of kolanuts and the by-products have also been developed to increase the local and foreign exchange earning power of kola. Highlights of some of the improvement strategies on kola are as follows:

Provision of Improved Planting Material: An improved kola planting materials can now be raised by using standard propagation techniques (seeds or vegetative means) developed by CRIN. Kolanuts show strong dormancy, therefore to ensure uniform germination; seeds for propagation should be harvested when completely mature and should be of large size. They should be uniformly cured (processed) and stored for up to 5 months. Seeds should be scarified to ensure faster germination. Kola seeds should be pre-germinated first in shaded seed boxes filled with moist sawdust. The nuts should be planted horizontally on their sides to a depth of 3 cm below the surface, such that they are partially exposed. The nuts should be watered and covered with transparent polythene sheets. Germination is usually completed within 80 days in *C. nitida* and 60 days in *C. acuminata* [16]. The pre-germinated nuts are planted in baskets or poly bags filled with topsoil, at a depth of 7-10cm. They are adequately watered and kept under shade to develop in the nursery. The seedlings will reach transplanting size in 6-8 months. The shades should be gradually removed as the seedling development progresses.

Vegetative propagation of kola trees has proven to be a practical proposition, especially for the multiplication of outstanding materials. Cuttings for vegetative propagation should be taken from new growth, which has just hardened, approximately two months after flushing. The cuttings should be from trees, which have proved to be high yielding. The cuttings are planted in concrete propagators or wooden boxes with a height of 60-75cm that allows sufficient space for the rooting medium. The cuttings should be 15-20 cm long [16, 26]. Cuttings are to be collected when it is cool and humid, preferably in the mornings or late evenings. If the materials are collected from trees close to the propagator, it can be enclosed in polythene bag to prevent moisture loss. In case the cuttings are to be transported over long distances, they should be placed in a bucket, with their bases in, water and covered with polythene sheet. The cuttings should be transferred to the propagator as fast as possible. The few lower leaves on the cuttings are removed, together with any flower buds. The apical tuft of six or more are left. Subsequently, the cuttings are cut at the base with a sharp knife, under water, to provide a fresh clean surface and then they are placed, obliquely, in the rooting medium to a depth of 10cm. This should be followed immediately with intensive watering regime, but care should be taken not to waterlog the propagator.

The roots start to develop from callus tissue at the base of the cutting, on average nine weeks after setting [16]. Successfully rooted cuttings are potted in rigid containers of at least 40cm high and 25cm wide in order to provide sufficient space for the new root. It is a must to use rigid containers because in flexible pots the newly formed roots are likely to break, as they are very brittle. The practice of potting cuttings in baskets, just like kola seedlings has been successfully perfected at the Cocoa Research Institute of Nigeria [16, 26].

Establishment of New Kola Farms: There is an abundance of soils of high, medium to low fertility that can be strategically exploited for kola cultivation in an effective land utilization policy in Nigeria. Such suitable soils have long been identified in the following parts of the country: South-western states (most parts of the six states); Edo state (most of the southern areas); Delta state (most of the non-riverine areas); South Eastern states (most parts of the five states); Cross-rivers state (most parts of the state); Akwa Ibom state (most parts of the state); Rivers state (the non riverine areas); Kwara state (Ilorin area); Kaduna state (Zaria area); Adamawa/Taraba state (the southern parts of the state); Kano state (areas around rivers and streams if irrigation is provided, especially during establishment stages); Niger state (Mokwa and large areas of the upper part of River Niger provided irrigation is available); Benue/Plateau/Kogi states (Oturkpo and Karba areas) and Nasarawa state (Lafia area) [8, 16]. These suitable soils scattered all over the country could be utilized for new plantings of improved kola varieties to ensure high productivity for both local and international markets.

Rehabilitation of Kola Orchards: One of the most important problems confronting production of kola in Nigeria is low productivity of existing old trees, which can be attributed to poor farm maintenance, attacks of pests and diseases, neglect of farm, decline in soil fertility and old age. It is known that about 50% of the existing kola trees yield insignificant produce of 0 -100 nuts per tree per year [23]. There is therefore large wastage of land in the kola industry especially in the western states. A more

efficient utilization of land can be achieved by the cutting down of unproductive trees and replacing them with proven materials. Alternatively old kola trees can be regenerated by coppicing at 30-60 cm from ground level. The cut surface should immediately be coated with red paint. The coppiced stumps start forming outgrowths or swellings from 2 to 3 weeks after coppicing. Within 3 months, buds start sprouting from the swellings and these develop into young shoots. Usually many shoots develop on the stumps and the abundance of young growth attracts many pests, however, the shoots are gradually thinned down to one or two per stump. Coppicing should be done around July or December and the maximum percentage regeneration is reached between 9 to 12 months after coppicing.

Harvesting: Kola fruits usually mature in 4-5 months after pollination; at this stage the fruit is inconspicuously brown and changes in colour from deep green to a paler tint. It is then ripe for picking. During the harvesting period the under growth beneath the kola tree is removed to ensure that both harvested and fallen fruits can be easily collected. Ideally the harvesting should be carried out before the pods begin to split and fall on the ground to guard against infestation by the kola weevils, *Balanogastris kolae* or *Sorphrorhinus* spp. Harvesting should be carried out once or twice a month during the fruiting season beginning from September to the end of January. Sporadic fruiting often occurs in July /August, but the peak production period is from October - December for *C. nitida* and April-June for *C. acuminata.* In a situation where the fruits are accessible during harvesting they are harvested with a sharp cutlass, but where the fruit are out of easy reach (in case of tall trees), they are harvested with a hooked knife, Sickle or Go-To-Hell attached to a long bamboo. The harvested fruits are gathered in a heap under the trees from which they are harvested and are later collected and removed to a central spot where the follicles are carefully cut open and the seeds extracted. From there they are carried in baskets to the village for skinning. The middlemen often purchase the pods or unskinned nuts at this stage.

Processing and Storage of Kolanut: Kolanuts are extracted from the pods and soaked in water or buried in moist sand or made into lightly watered heaps for 24 hours to ease skinning. The skinned nuts are then washed and placed in unlined baskets, covered lightly with banana leaves and left for a few days (about 5) to "sweat" - a process which reduces the water content of the nuts. The nuts are later placed in fresh leaf-lined baskets and covered lightly with leaves. Periodically, the nuts are stirred to prevent over-heating and to produce uniform curing. As the nuts are stirred, defective nuts (weeviled nut, mouldy, nut, etc) are discarded. The curing takes about 3 weeks. Kolanuts cured in this way can be stored, if necessary, in baskets lined with fresh leaves or thin black nylon sheets and if the place is cool they will keep for months without spoilage. All that is needed is occasional renewal of the leaves used to line the baskets. Kolanuts for export are usually sun-dried.

Control of Kola Pests: Only cultural methods are recommended for the control of kola weevils in storage. Use of pesticides are discouraged because the nuts are consumed in its raw form without further processing and the health hazards posed by the long term effects of pesticide residues on consumers is of great concern to experts. Cultural practices involving early harvesting of mature kola pods, prompt removal of fallen and hanging mature pods at the end of the season, as well as the removal of dead and moribund pods between crops have been suggested as effective and economic methods of reducing the level of insect pest infestation in kola [1, 27, 28]. Idowu and Ojelade [29, 30] observed that minimal level of weevil damage (35.4%) was recorded on kolanuts which were obtained from timely harvested pods, when compared with 58.3% - 83.3% of nuts obtained from pods whose harvest were delayed.

Other cultural control measures include destruction and proper disposal of all debris from the nuts and the replacement of earthen floors at kolanut depots with cemented ones [31]. Ndubuaku [32], also advocated that since the kola weevil exhibit positive geotaxis, the farmers should concentrate on the physical removal of adult weevils from the bottom of the baskets and that the crevices at the bottom of the baskets should be thoroughly inspected during regular replacement of banana leaves to ensure that the weevils hiding at the bottom of baskets were not overlooked. Daramola [11] and Ojo [33], also recommended cultural field practices such as poking of larvae of *Phosphorous viriscens* in the tunnel with long wires or cutting and removal of stems containing the larva. The method was found to be effective even though it is labour intensive. Also the dehusking of pods far away from kola grooves and burying of pod husks which habour developing larvae reduced the level of the kola pod borer *Characoma stictigrapta* population in the field [34].

Control of Diseases of Kola: The cutting and uprooting of the infected kola trees and their subsequent removal from the plantation is the most effective way of controlling serious kola diseases in the field. Control of the nut diseases is complicated by the nature of the crop and the condition under which it must be stored in order to retain its freshness. Treatment of the nuts with pesticides is not advisable as they are eaten raw and fresh without further processing. However, applications of cultural control, sanitation during primary processing, use of mild chemicals and plant extracts have been recommended by CRIN [35]. The use of Nitrogen gas gave effective control of the storage fungi [36], while a substantial reduction of post-harvest loss has been achieved in nuts stored in baskets lined with polyethylene sheet over banana or plantain leaves. Constant picking and destroying of affected nuts also minimizes infection. According to Agbeniyi and Fawole [37] and Agbeniyi *et al.* [35], soaking of nuts in solution of 1% sodium hypochlorite (Milton solution) immediately after skinning minimizes microbial infection of kolanuts. Also Otuonye and Adedeji, [38, 39], recommend the use of botanicals such as *Ocimum gratissimum* and *Azadirachta indica* leaf extracts for soaking kola nuts against storage rot pathogens.

DISCUSSION AND CONCLUSION

Kola is an indigenous crop to West Africa unlike cocoa, cashew, coffee, tea, mango, oranges, pear etc that can be traced to other continent as their ancestral origin. As a major stake holder charged with kola development, improvement, marketing and publicity, the Cocoa Research Institute of Nigeria (CRIN), Ibadan, Nigeria has measured up to the task of uplifting the standard of this crop to a level worthy of emulation by other countries and continents.

The benefits accruing from kola is quite enormous. The most famous beverage in the world, “Coca-cola” was invented from kola in 1886 by an Atlanta druggist, Dr. John S. Pemberton and marketed as a “brain and nerve tonic” [40, 41]. But for the fact that kola does not grow else where in the world outside Africa and the resolve for the imperialists to underdeveloped Africa, Coca-cola abandoned real kola for synthetic kola chemical flavours. Till date they import their formulated concentrates from abroad to any of their bottling plants in African continent. The resuscitation of this all-important crop occasionally referred to in some quarters as the “black gold” is in our hands. The government at the appropriate levels should speed up efforts in providing the necessary inputs, infrastructures and support services so as to remove the major constraints of kola production.

Previous research recommendations based on monocropping, oriented towards foreign farm practices, which are not based on the traditional farming system or which ignore an all-embracing farming system approach should be presently ignored. This is because such recommendations do not make allowance for alternative sources of income, apart from sidetracking the age-long traditional practice of mix-cropping and intercropping and farmers’ attitude to completely new recommendations. Research recommendation for kola production should therefore take into cognizance the culture and tradition of the farming community. Also the adoption trials of such recommendations should be demonstrated to the farmers at designated demonstration plots within their community. The Research Institutions should always transfer their latest technologies and achievements to the farmers immediately rather than keep it in their shelves, as has been the case over the years.

However, the research findings at the Cocoa Research Institute of Nigeria have tremendously reduced the genetic, agronomic and pest/disease problems associated with kola production. Improved and high yielding kola-planting materials with lower gestation period (5 yrs) are now available for the establishment of new plantations. New technologies have also been developed on the utilization of the by-products of the crop. The appropriate application of the strategies suggested in this paper will no doubt transform to positive developments such as employment generation, rural development and a boost of the non-oil revenue base of the country and that of Africa in general.

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REFERENCES

1. Eijnatten, C.L.M. Van, 1969. Kola. Its botany and cultivation. *Communication* No. 59. Roy. Trop. Inst. Amsterdam, pp: 100.
2. Quarcoo, T., 1973. A handbook on kola. CRIN Ibadan, pp: 99.

3. Jacob, V.J., 1973. Yield characteristics; incompatibility and sterility studies in *cola nitida* (Vent) Schott and Endlicher. Ph.D thesis University of Ibadan, pp: 159.
4. Pala, A.O., 1976. African women in rural development: Research trends and priorities. In: OLC Paper (USA), no. 12 / American Council on Education, Washington, D.C. Overseas Liaison Committee, pp: 39.
5. Oluokun, J.A. and Oladokun, 1999. The effects of graded levels of brewers spent grains and kolanut pod meal in the performance characteristics and carcass quality of rabbits. Nigerian J. Animal Production, 26: 71-77.
6. CBN (Central Bank of Nigeria), 2002. Memorandum of the Central Bank of Nigeria on Agricultural Financing. Presented at the 32ND regular meeting of the National Council on Agriculture And Rural Development holding at Yola Adamawa State from 9th to 15th February, 2002, pp: 10.
7. Lowor, S.T., P.C. Aculey and M.K. Assuah, 2010. Analysis of some quality indicators in cured Cola nitida (vent). Agriculture and Biology J. North America, 1(6): 1206-1214. Available online @ www.scihub.org/ABJNA.
8. FDA (Federal Department of Agriculture), 1973. National Agricultural Development Committee. Report of The Study-Group on Cocoa, Kola, Coffee and Cashew. Lagos, pp: 63-120.
9. Beattie, G.B., 1970. Soft drink flavours: Their history and characteristics. 1: Cola for kola Flavours. The Flavour Industry, pp: 390-394.
10. Eka, O.U., 1971. Chemical composition and use of kolanuts. J.W. Afr. Sc. Ass., 16: 167-169.
11. Daramola, A.M., 1978a. Insect pest of kola in Nigeria. Research Bulletin. CRIN, Ibadan, 3: 33.
12. Oguntuga, D.B.A., 1975a. Chemical composition and potential commercial uses of kolanuts, *Cola nitida* (Vent) Schoot and Endl. Ghana J. Agric. Sc., 8: 121-125.
13. Oguntuga, D.B.A., 1975b. Chocolate and Wine from kolanut. Daily Times, pp: 16.
14. Famuyiwa, O.O., 1987. Cocoa and kola wine. Ann. Rep. CRIN, pp: 63.
15. Egbe, N.E. and O. Sobamiwa, 1989. Utilization of Cocoa, Kola, Coffee, Cashew and Tea in Nigeria. In Progress in Tree Crop Research CRIN, Ibadan, pp: 217-224.
16. Opeke, L.K., 1992. Tropical Tree Crops. Woye and Sons Nig. Ltd. Ilorin, Nigeria, pp: 237.
17. Olubamiwa, O., R.A. Hamzat, R.R. Ipimoroti, C.O. Jayeola and L.E. Yahaya, 2002. Current advances on the utilization of kola and by-products in Nigeria. Paper presented at an investors forum on kola Kola and by-product utilization for National development Organized by CERUD, CRIN, RMRDC, NEPC and KOLAN. Ikorodu, Lagos, pp: 10.
18. Yahaya, L.E., R.A. Hamzat, S.O. Aroyeun and M.I. Odufuwa, 2002. Production of liquid soap detergents from the pod husk of kola (*Cola nitida*), Moor J. Agric. Res., 3(2): 252-256.
19. Hamzat, R and B.B. Babatunde, 2001. Performance characteristics of broiler finishers fed kola (*Cola nitida*) Vent. (Schott and Endl) pod husk-based diets. Moor J. Agric. Res., 2(2): 153-158.
20. Hamzat, R.A. and O.G. Longe, 2002. Potentials of kola testa as a sole feed for Archachatina marginata snails raised under kola plantation. Nig. J. Tree Crops Res., 4(2): 1-19.
21. Hamzat, R.A., C.O. Jayeola and O.G. Longe, 2002. Nutritional quality of snails (*Archachatina marginata*) fed solenly with fresh kola testa. Nutrition and Food Sci., 32(4): 134-136.
22. Hamzat, R.A., A.J. Omole, B.B. Babatunde, M.O. Adejumo and O.G. Longe, 2007. Comparative value of kola testa, corn-bran and rice-bran with maize for mature African gaint land snail (*Archachatina marginata*). African Crop Science Conference Proceedings, Egypt, 8: 2127-2132.
23. Okoloko, G.E. and V.J. Jacob, 1971. Kola Breeding in Nigeria. In Progress in Tree Crop Research. CRIN, Ibadan, Nigeria, pp: 23-33.
24. Ndubuaku, T.C.N., 1989. Economic insect pests of kola. In Progress in Tree Crop Research. 2nd Ed. CRIN, Ibadan, Nigeria, pp: 115-126.
25. Daramola, A.M., 1973. The bionomics of kola weevils, S*ophrorhinus* spp. (Coleoptera: Curculionidae). Ph. D. Thesis. University of Ibadan, Nigeria, pp: 325.
26. Adenikinju, S.A., E.B. Esan and A.A. Adeyemi, 1989. Nusery techniques, propagation and management of Cocoa, Kola, Coffee, Cashew and Tea. In Progress in Tree Crop Research. CRIN, Ibadan, Nigeria, pp: 1-27.
27. Daramola, A.M., 1974. Studies on the survival of the kola weevils between seasons of kola production in Southern Nigeria. Turialba, 20(3): 309-301.
28. Daramola, A.M., 1976. Effect of harvesting regime on weevil infestation of kolanuts in Southern Nigeria. Nig. J. Pl Prot., 2: 78-88.

29. Idowu, O.L. and K.T.M. Ojelade, 1994. The effects of cultural maintenance operations in kola farms on field infestation of *C. nitida* nuts by the weevils. Ann. Rep. CRIN, Ibadan, Nigeria, pp: 28-30.
30. Idowu, O.L. and K.T.M. Ojelade, 1995. Effects of timeliness of kola pod harvesting on weevil infestation in the field. Ann. Rep. CRIN, pp: 28-30.
31. Daramola, A.M. and T.A. Taylor, 1975. Studies on the re-infestation of kola in store by kola weevils in S. Nigeria. Nig. J. Stored. Prod. Res., 11: 61-63.
32. Ndubuaku, T.C.N., 2000. Preliminary studies on the incedence and morphology of the kola flower insect *Torma colae* Chna. (Hemiptera:Miridae) in Nigeria. Bioscience Research Communications, 13(6): 7.
33. Ojo, A., 1981. Investigations into the control of the kola stem borer *P. virescens* Oliver (Cerambycidae: Coleoptera) in Western Nigeria. Turrialba, 31(3): 1.
34. Daramola, A.M., 1978b. Common pests of Kola and Cacao with special reference to *Characoma Stictigrapta* Hmps and *S. singularis* Hagl damage to kola in Nigeria. Paper presented at the 6th W. Afr. Cocoa Entomologists Conference. CRIN Ibadan, 7: 6-10.
35. Agbeniyi, S.O., A.H. Otuoye and A.R. Adedeji, 2000. Mycoflora Associated with Post Harvest Processing stages of kolanuts (*Cola nitida* vent schott and Endlicher). The J. Food Technol. In Africa, 5(4): 129-131.
36. Oludemokun, A.A., 1976. Effect of temperature and relative humidity on mould deterioration of stored kolanuts Cola Nitida. Plant Dis. Rep., 60(12): 1008-1010.
37. Agbeniyi, S.O. and B. Fawole, 1999. Effects of curing and pre-storage disease treatments on mould of kolanuts. European J. Food Res. and Technol., 208: 447-449.
38. Otuonye, A.H. and A.R. Adedeji, 2006. Evaluation of selected plant extracts for the control of the storage rot diseases of kolanuts. Annual Report of the Cocoa Research Institute of Nigeria, Ibadan, pp: 29-30.
39. Otuonye, A.H. and A.R. Adedeji, 2010. Management of *Lasiodiplodia theobromae* black rot of kola nuts in storage using Neem plant extract: Preliminary report. J. Res. In Biosci., 6(1): 48-52.
40. Constance, L. Hays, 2004. The real thing: Truth and power at the coca-cola company New York. Random House.
41. Wikipedia, 2011. John Pemberton. Available online @ http://en.wikipedia.org/wiki/John_pemberton. Retrieved 9th October, 2011.