ANNUAL REPORT

OF THE

COCOA RESEARCH INSTITUTE OF NIGERIA, IBADAN

2007

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PRINCIPAL ADMINISTRATION AND RESEARCH STAFF LIST AS AT 31 DECEMBER, 2007

Internal Management Committee Members

1	Executive Director	Prof. G.O. Iremiren	B.Sc., M.Sc., Ph.D
2	Director (P&S)	Dr. (Mrs) F.A. Okelana	B.Sc., M.Phil & Ph.D
3	Director (R)	Dr. O. Olubamiwa	B.Sc., M.Sc., Ph.D
4	Director (FRS&E)	Dr. E.O. Aigbekaen	B.Sc., M.Sc., Ph.D
5	Director (PBM&T)	Dr. O.A. Fademi	B.Sc., M.Sc., Ph.D
6	Asst. Director	Dr.(Mrs) L.N. Dongo	B.Sc., MPA, MNIM
7	Administrative Secretary	Mr. J.O. Babafemi	B.Sc., MBA
8	Chief Accountant Internal Auditor	Mr. O.S. Adefaka Mr. K.M. Fabowale	OND, HND, MBA, ANAN, AMNM
9	Chief Librarian	Mr. O.O. Fagbami	B.Sc., MLS
10	Maintenance Engineer	Mr. A.T. Bakare	B.Eng., PGDIP (Metallurgy) PGDIP (Bus. Ind. P/Mgt.)

PLANT PATHOLOGY

1	Dr. (Mrs.) L.N. Dongo	B.Sc., M.Sc., & Ph.D
2	Dr. S.O. Agbeniyi	B.Sc., M.Sc., M.Phil, Ph.D
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4	A.H. Otuonye	B.Sc.
5	M.O. Okeniyi	B.Agric.
6	S. Orisajo	B.Sc., M.Sc.

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3	Dr. O.M. Aliyu	B.Sc., M.Sc., Ph.D
4	P.O. Aikpokpodion	B.Sc., M.Sc.
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4	L.A. Hammed	B.Sc., M.Sc.
5	A. Oloyede	B.Sc., M.Sc.
6	K.O. Ayegboyin	B.Sc., M.Sc.

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7	L.A. Adebowale	B.Sc.
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4	L. E. Yahaya	B.Sc., M.Sc.
5	S. O. Aroyeun	B.Sc., M.Sc.
6	S. O. Ogunwolu	B.Sc., M.Sc.
7	M. A. K. Ogunjobi	B.Sc., M.Sc.
8	A. A. Ajao	B.Sc., M.Sc.
9	B. Adebowale	B.Sc., M.Sc.
10	R. O. Igbinadolor	B.Sc., M.Sc.
11	F. C. Mokwunye	B.Sc., M.Sc.
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3	R. A. Sanusi	B. Agric. M.Sc.
4	K. A. Oluyole	B.Sc., M.Sc.
5	Mrs. J. O. Lawal	B. Agric. M.Sc.
6	B. O. Obatolu	B. Agric. M.Sc.
7	Mrs. M. Adejumo	B.Sc.

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1	Dr. E. O. Aigbekaen	B.Sc., M.Sc. & Ph.D
2	S. O. Adeogun	B.Sc., M.Sc.
3	E. O. Uwagboe	B.Sc., M.Sc.
4	E. A. Agbongiarhuoyi	B. Tech. M.Sc.
5	S. Adebiyi	B. Tech.
6	I. Ndagi	B. Agric.

HEAD OF STATIONS

1	Dr. S.O. Agbeniyi	Ajassor
2	Mr. T.C.N. Ndubuaku	Owena
3	Dr. S.S. Omolaja	Mambilla
4	Dr. O.O. Oduwole	Ochaja
5	Mrs. U.N. Umeregini	Ibeku
6	Dr. A.O. Famaye	Uhonmora

LIST OF YEAR 2007 SENIOR STAFF PROMOTION

S/N	NAMES	DESIGNATION/PROMOTED TO THE POST OF	CONTISS	REMARKS
1.	Dr.(Mrs) F.A. Okelana	Asst. Director	14	1/10/07
2.	Dr. O. Olubamiwa	Director	15	"
3.	Dr. E.O. Aigbekean	Director	15	"
4.	Dr. A.O. Fademi	Director	15	"
5.	Dr(Mrs.) L.N. Dongo	Asst. Director	14	"
6.	Babafemi J.O.	Asst. Director (Admin &Supplies)	14	"
7.	Adefaka S.O	Asst. Director (F&A)	14	"
8.	Asogwa E.U	Principal Research Officer	11	"
9.	Ogunwolu S.O.	Principal Research Officer	11	"
10.	Adejumo M.O. (Mrs)	Research Officer I	8	"
11.	Adebiyi S.	Research Officer I	8	"
12.	Okeniyi M.O.	Research Officer I	8	"
13.	Mokwunye F.C.	Research Officer I	8	"
14.	Ndagi I	Research Officer I	8	"
15.	Adebowale L.A.	Research Officer I	8	"
16.	Dada K.E	Research Officer I	8	"
17.	Lawal O.R.	Chief Agric. Superintendent	13	"
18.	Adeleke R.A.	Chief Agric Supt.	13	"
19.	Ogunleye B.M.	Principal Agric Supt. II	09	"
20.	Oguigo P.	Higher Agric Supt.	07	"
21.	Ojo O.A	Chief Agric Field Overseer	06	"
22.	Folarin V.A.	Library Officer	06	"
23.	Arowobusoye S.O.A.	Chief Graphic Arts Officer	13	"
24.	Olukotun O.S	Snr. Admin Officer	09	"
25.	Onigbinde O.O	Snr. Accountant	09	"
26.	Nwosu J.N	Accountant I	08	"
27.	Deji E.A	Chief Executive Officer	09	"
28.	Agwimah J.A.	Principal Executive Officer	09	"
29.	Farinola P.A.	Principal Executive Officer	09	"
30.	Oguntuase J.I.	Executive Officer	06	"
31.	Fabowale (Mrs)	Chief Clerical Officer	06	"
32.	OgungbadeB.T.	Chief Clerical Officer	06	"
33.	Bakare A.T.	Snr. Maint. Engineer	09	"
34.	Agwimah E.O.	Snr. Tech. Officer	08	"
35.	Ogbechie C	Snr. Foreman	06	"
36.	Amusan L.A. (Mrs)	Snr. Foreman	06	"
37.	Basseye M.E.	Chief Motor Driver Mech.	06	"
38.	Olaosebikan A.O	Snr. Typist Gd.II	06	"

LIST OF YEAR 2007 JUNIOR STAFF PROMOTION

S/N	NAMES	DESIGNATION/PROMOTED TO THE POST OF	CONTISS	REMARKS
1.	Onipe O	Asst. Chief Agric Field Overseer	5	1/10/07
2.	Adishetu Ndasheu	Agric Field Overseer	2	"
3.	Hammed L.A.A.(Mrs)	Snr. Data Processing Asst.I	5	"
4.	Babatunde J.M.	Clerical Officer I	4	"
5.	Olabiyi B.F. (Mrs)	Clerical Officer I	4	"
6.	Arowosafe F.F. (Mrs)	Clerical Officer I	4	"
7.	Sardauna A.Y.	Clerical Officer I	4	"
8.	Thomas E.	Snr. Security Guard	4	"
9.	Okoujaboule S	Snr. Security Guard	4	"
10.	Oke Babatunde	Foreman	5	"
11.	Oyebanjo T.	Foreman	5	"
12.	Francis Wakaps	Snr. Craftsman	4	"
13.	Enodunwenben A.	Snr. Motor Driver Mech.	4	"
14.	Oyebode F.A (Mrs)	Asst. Executive Officer	5	"
15.	Akinyode B (Mrs.)	Typist Gd.I	5	"
16.	Ejenebor F.B(Mrs)	Typist Gd. I	5	"
17.	Alade B.F.(Mrs)	Typist Gd. I	5	"
18.	Otitoloju O. (Miss)	Typist Gd.II	4	"

APPOINTMENT OF 2007 (CONTRACT)

SN	NAME	DESIGNATOR
1.	Mr. L.O. Raji	Agric. Supt
2.	Mr. W.T. Anikudi	Motor driver
3.	Mr. B.O. Oguntonade	Motor Driver

2007 LEFT THE SERVICE

S/N	Name	Designation	Sal. Grade CONTISS	Deployment	Date of 1st Appt	Date of Exit	Mode of Exit
1	Akanni A. S. B	Asst. Chief Accountant	12	Fin & Acct	16/6/72	16/6/07	Comp. Retirement on Account of Length of Service
2	Ajani Adeyinka	Asst. Chief Agric Supt	12	Ochaja S/S	24/1/72	24/1/07	Comp. Retirement on Account of Length of Service
3	Odeboju E. A	Asst. Chief Agric Supt	13	P/Pathology	12/1/72	12/1/07	Comp. Retirement on Account of Length of Service
4	Farinola V. O (Mrs)	Senior Catering Asst.	05	Admin & Supplies	1/4/72	1/4/07	Comp. Retirement on Account of Length of Service
5	Erugba Sunday	Senior Agric Supt	04	PEM	21/2/96	24/4/07	Comp. Retirement on Account of Age
6	Olutade J. O	Chief Agric. Supt	13	Entomology	8/6/72	8/6/07	Comp. Retirement on Account of Age
7	Olorunmota V. I	Chief Agric Supt	13	PEM	12/6/72	12/6/07	Comp. Retirement on Account of Length of Service
8	Yabagi A. A	Research Officer II	07	Econs & Statis	24/4/02	19/6/07	Transfer of Service
9	Odunmorayo J. A	Asst. Chief Executive Officer	12	Acct. & Finance	1/8/72	1/8/07	Comp. Retirement on Account of Length of Service
10	Mrs V. M. Odeleye	Chief Typist	08	P/Breeding	23/10/72	23/10/07	Comp. Retirement on Account of Length of Service

S/N	Name	Designation	Sal. Grade CONTISS	Deployment	Date of 1st Appt	Date of Exit	Mode of Exit
11	Adebayo Olusegun	Chief Agric Supt	13	P/Pathology	28/6/72	28/6/07	Comp. Retirement on Account of Length of Service
12	Atunramu, R. A	Prin. Lab. Tech	09	CPU	13/7/72	13/7/07	Comp. Retirement on Account of Length of Service
13	Beka, Sabath E.	Chief Agric Field Overseer	06	Ajassor S/S	1/8/72	1/8/07	Comp. Retirement on Account of Length of Service
14	Ajayi Stephen O.	Chief Agric Field Overseer	06	Econs & Statis	10/11/72	10/11/07	Comp. Retirement on Account of Length of Service
15	David Ojo	Agric. Field Attendant I	03	Nursery	10/6/95	10/2/07	Comp. Retirement on Account of Age
16	Idakpo Samuel	Head Watchman	03	Ochaja S/S	9/12/96	7/12/07	Comp. Retirement on Account of Age
17	Olaiya, A. O	Prin. Research Officer	11	Agronomy	2/8/99	1/3/07	Withdrawal from serv.
18	D. Nwachukwu	Senior Security Guard	04	Ibeku S/S	3/7/78	6/2/07	Voluntary Retirement
19	Basiru Busari	Senior Foreman	06	Engineering	5/5/72	5/5/07	Comp. Retirement on Account of Length of Service
20	Nwodo Emmanuel	Senior Foreman.	06	Engineering	6/6/72	6/6/07	Comp. Retirement on Account of Length of Service
21	Odozor, R. A	Chief Agric Field Overseer	06	Ibeku s/S	1/4/74	17/6/07	Comp. Retirement on Account of Age

IN HOUSE SERVICE TRAINING

SN	Names/Designation	Events/Courses of Study	Duration	Sponsoring	HostOrganisation/ Organizer of Events	Purpose
1.	Mrs. J.O. Lawal – RO. I	Facilitate Multistakeholder process and social learning	10-28 Sept.,2007	Self Sponsorship	Wageningen Netherland	
2.	Mrs. M.O. Adejuno – RO II	Facilitate Multistakeholder process and social learning	"	"	"	
3.	Dr. L.N. Dongo - CRO	Leadership and Adaptive Management	"	"	"	
4.	Mr. L.A. Emaku - Principal Statistical Officer	A course on Statistical Computing and report generation using SPSS EPINFO etc.	19 – 30 Nov., 2007	CRIN Sponsorship	The Consultancy Service Centre Obafemi Awolowo University Ile-Ife	
5.	Mrs. L.A. Busari Principal Statistical Officer	"	"	"	"	
6.	Mr. Idris Ndagi	Occoquan Project	13 – 17 Feb., 2007		Accra, Ghana	
7.	Mr. Daniel M.A. – RO.I	Water Harvesting and Reservoir	2 weeks Course Starting from 29 October 2007	CRIN Sponsorship	Mashau Abjurab International Training Centre (MAITC).	
8.	Dr. (Mrs.) L.N. Dongo – Director (Path)	Leadership and Adaptive Management	1/10/2007 to 09/11/2007	Self Sponsorship	Wageningen Netherlands	

COCOA PROGRAMME

Experimental Title: Evaluation of cacao (*theobroma cacao* l.) clones for resistance to root-knot nematode meloidogyne incognita. (Okeniyi, M.O., Fademi, O.A. Aikpokpodion, P. and Orisajo,S.B.)

Introduction

The production of cocoa in Nigeria has witnessed a downward trend since the early 1970s due to numerous factors: ageing trees, poor application of recommended agronomic techniques by farmers
and the effects of pests and diseases. Root-knot disease caused by *Meloidogyne* spp. is a well-known disease of many tropical and sub-tropical crops. Earlier studies in Brazil, the Congo, Ghana and Nigeria have shown that they are the most important nematodes of cacao die to their pathogenecity and wide distribution in cocoa producing regions (Campos & Villain, 2005). It is a common pest of cacao in West Africa (Whitehead, 1969; Asare-Nyako & Owusu, 1979; Afolami and Caveness, 1983; Fademi et al., 2006). These inadicate that root-knot nematodes do damage cacao seedlings immensely. Root-knot nematodes have also been found to e very dominant on a few plots o which cacao establishment had
been difficult (Fademi et al., 2006). Use of chemical nematicides is one of the primary means of controlling plant parasitic nematodes. However, their potential negative impact on the environment and human health has led to a total ban or restricted use of the most nematicides and an urgent need for safe and effective control options for plant parasitic nematodes (Nico et al., 2004). Resistant crop cultivars have proven to be commercially successful in the control of plant-parasitic nematodes (Abad et al., 2003).

According to Paal et al. (2004), the exploitation of host resistance is the most effective and environmentally-benign method of managing plant nematodes. All this brought into focus the need to subject some of the clones recently certified has been resistant to black pod disease in Nigeria (Otuonye et al., 2007) to a screening exercise for root-knot nematode resistance. The basis of cacao evaluation for selection has always included establishment ability and resistance to diseases and pests (Atanda, 1975). Establishment ability is a factor that is most crucial. Root-knot nematodes can be a nuisance to the farmers. An unpublished set of data indicates that cacao establishment has been made impossible on an experimental plot partly because of heavy root-knot and other nematodes infection. It is for this reason that this work was initiated to provide more information on the suitability of these ten clones for commercial use.

Materials and Methods

The pathogenecity experiment was conducted in the greenhouse of the Cocoa Research Institute of Nigeria, Ibadan, Nigeria and was re-validated in the nursery. Ten clones of cacao namely MXC67, T86/2,PA150, LCTEEN, T12/11, T53/5, T101/15,T65/7,ICSI and AMAZ15-15 were used. The greenhouse and nursery experiment was laid out in a Completely Randomized Design with four
replicates. The two factors were *M.incognita* inoculums at two levels (0 and 5000 *eggs* per seedlings)
and the six cocoa clones. Two seeds of the appropriate cocoa coles were sown in each of the pots in January 2007; eight pots for each of the twelve clones. Seedlings were thinned to one per pot at five days after emergence. On the seventh day, the seedlings in four of the eight pots of each cocoa clone were inoculated with 5000 *M.incognita* eggs extracted from a culture of the nematode maintained on *Celosia argentea*L., roots. *Meloidogyne incognita* used as inoculums was maintained on *Celosia argentea* grown in a microplot. The culture was initially started from a simple egg mass of *M.incogentea*. The eggs were extracted from galled roots of *Celosia argentea* using the sodium hypochlorite (NaOcl) method

of Hussey and Braker (1973). The eggs collected on the 500-mesh sieve were rinsed with distilled water to remove the residual NaOcl. Concentration of the egg suspension was determined by removing one aliquote and the number counted in a counting dish under a stereomicroscop. This was repeated four times and the average number of eggs recorded. Inoculation of the plants was done by pipetting desired volume of eggs suspension into the holes made around plants. The plants were examined for nematode reaction according to the scale of Taylor and Sassor (1978) as follows: 0=0galls; 1=1-2galls; 3=3-10galls; 4=31-100galls and 5= above 100galls. Afolami et al., (2000), Quantitative scheme for assigning crop into resistant categories was used for the clone rating. Soil and root samples were also taken from each of the clone for soil nematode. Soil nematode population was estimated using Coyne et al., 2007 modification of Baermann funnel method.

Results

The reaction of the ten clones is presented in Table 1. The result indicated that MXC67, T86/2, PA150, and F3 Amazon had the highest mean gall index of 3.0 respectively. LCTEEN had the least gall index of 1.0per root system both in the green house and in the nursery and was closely followed by T12/11 that had the mean gall index of 2.0 per root system. The highest mean soil nematode population of 8433 and 8450 per 250ml soil was recorded for PA150 in the green house and in the nursery respectively, while MXC67 and 6750 per 250ml soil, T86/2 had 7665 and 750 per 250ml soil. The least population of 4850 was recorded with LCTEEN. On the basis of these results, MX67, T86/2, PA150 and F3 Amazon were found to be susceptible and LCTEEN and T12/11 were rated resistant.

The effect of *M.incognita* on plant growth and early development of the ten clones are presented in Table 2. The presence of nematode significantly reduced the height of PA150, T101/15, f3 Amazon and Amelonado. However, nematode inoculation significantly increases the heights of clones, T86/2, LCTEEN, T12/11,T53/5,ICSI and AMAZ 15-15. For leaf number, nematodes presence significantly reduced leaf numbers in clones MXC67, T86/2, PA150,T101/15,F3 AMAZON and Amelonado. The inoculated plants manifested narrow leaves in the 16th week, which later led to lead drop that gave them unthrifty appearance. F3 Amazon and Amazon began the manifestation of chlorosis sixteen weeks after infection with *M.incognita.* The both manifested stunted growth and later investigation revealed poor root development with galls in these plants. The inoculated plant showed drastic effect of root-knot nematode infection a latter stage of growth by expressing reduction in leaf number. Nematode infection of T86/2 led to a reaction that stimulated a rapid growth but with plant reduced leaf number. Considering the root weight, the root growth for four clones were enhanced by nematode infection (Table 2). The clones are PA150, LCTEEN, T12/11 and AMAZ 15-15. Root investigation of clones revealed root-galling and damage in MXC67, T86/2, T101/11 and T53/5.

The growth responses of T. cacao clones infested with *M.incognita* in both the screen house and in the nursery is presented in Tables 3. Of the ten clones evaluated, LCTEEN and T12/11 gave the best vegetative plant characters such as plant height, number of leaf, stem girth, fresh root weight, fresh leaf weight and total dry matter. LCTEEN and ICSI gave the highest plant height, which was closely followed by MXC67 and T53/5. The least plant height was recorded in Amelonado. In terms of number of leaf AMAZ 15-15 followed by LCTEEN gave significantly better vegetative yield performance than others. In all the clones, evaluated T12/11 had a significantly high stem girth followed by LCTEEN, T53/5 and ICSI, while AMAZ 15-15 and Amelonado yielded the least stem girth. The fresh shoot weight was higher in T12/11 and followed by ICSI while the lowest shoot yield was recorded in Amelonado. LCTEEN and

T101/15 had the highest fresh root weight; this was followed by T12/11. F3 Amazon and Amelonado yielded the least root weight. T12/11 yielded the highest total dry matter followed by T101/15, F3 Amazon, Amelonado and T86/2 yielded the least total dry matter.

Percentage increase in plant height, number of leaves, stem girth, fresh root, fresh leaf, fresh shoot and total matter were shown in Table 4 and 5. AMAZ 15-15 showed an outstanding performance ever the other clones by exhibiting the highest percentage increase plant height, number of leaves, fresh root weight, fresh shoot weight, fresh leaf weight and the total dry matter (40.5%,95.5%,92.3%,136.4%, 60.3%, 133.2%,87% and 50%) respectively in the screen house and (35.8%, 80.8%, 0.6%, 95.8%, 46.7%, 61.9%, 77.1%, 38%, 54.8%) respectively in the nursery (P=0.05), based on this attributes it was rated as being resistant, this was closely followed by T12/11 in terms of plant height, fresh root weight, fresh stem weight and the total dry matter (7.8%, 49.9%,31.1% and 32.9%) in the green house and 2.8%,39.2%, 28.1/5 and 27.2%) in the nursery. LCTEEN in the presence of nematode had a percentage increase over the nematode-free plant in plant height, number of leaves, stem girth, fresh root weight, fresh leaf weight, dry stem weight and total dry matter (16.6%, 22.3%, 20%, 29.7%, 8.9%, 27.5%, 1.4% and 2% respectively in the screen house and 15.3%, 19.9%, 18.5%, 24.7%, 7.7%, 21.8% and 1.1% respectively and was rated resistant. T65/7 had a percentage increase over the control in terms of leaf number, stem girth, fresh stem weight and total dry matter (19.6%, 21.9%, 21.2% and 8%) in the nursery and 25%, 24.2%, 25.3% and 10.6%) in the green house. ICSI also performed better in terms of percentage increase over the control both in the green house and in the nursery, with increase in plant height, root weight, stem weight and total dry matter (23.8%, 16.7%, 12.6%, 69.2% and 2.6%) and (21.8%, 10%, 59.2% and 2.4%) respectively.

F3 Amazon and Amelonado were used as standard for the ten clones that were evaluated and when visually evaluated, F3 Amazon compared favorably with the best five clones (LCTEEN, T12/11, AMAZ 15-15, T65/7 and ICSI (Table 1), but was inferior in root growth to T65/7, LCTEEN and T12/11. Amelonado was inferior to all the clones evaluated.

Table 6, gives the response and rating of ten clones of cocoa using the modified version Afolami et al., (2000) quantitative scheme for assigning crop varieties into resistance categories, LCTEEN, T12/11 and AMAZ 15-15 were poor host of *M.incognita* and they exhibit resistant characteristics to the nematode, which was unable to reproduce on these clones. LCTEEN had a gall index of 1.0 reproductive factor of 0.97 with a mean dry matter slightly above that of the uninoculated. T12/11 showed a gall index of 2.0 and reproductive factor of 0.99 and a significant increase in total dry matter of 27.2%. AMAZ 15-15 showed a gall index of 2.0 and reproductive factor of 1.0 and a significant increase in total dry matter of 79% in inoculated than in control unit (P=0.05).

MXC67, T86/2, PA150,T101/15 and T53/5 were obviously very susceptible to the nematode, with MXC67 showing a gall index of 3.0 and a reproductive factor of 1.35 and suffering a significant total dry matter reduction of 37.8% in inoculated treatment than in control units (P=0.05), while T86/2 showed a gall index of 3.0 and a reproductive factor of 1.53 and suffers a significant total dry matter of 24.6% (P=0.05). PA 150 showed a gall index of 3.0 and reproductive of 1.69 with o significant total dry matter reduction of 15.4% in inoculated treatment than in control units (P=0.05). T101/15 showed a gall index of 3.0 and a reproductive factor of .24 and suffers a significant total dry matter reduction of 7.8% (P-0.05), while T53/5 showed a gall index of 3.0 and a reproductive factor of 1.20 and suffers a significant total matter reduction of 29.4% in

inoculated treatment than in control units (P=0.05).

In the case of T65/5 and ICSI, they showed a gall index of 2.0, reproductive factor of 1.43 and a significant total dry matter increase of 10.6% in inoculated treatment than in control units (P=0,05) and gall index of 2.0 reproductive factor of 1.45 and an increase in total dry matter of 2.6% in inoculated than in control units (P=0.05) respectively.

Based on this, MXC67, T86/2,PA150,T101/15 and T53/5, were rated as susceptible to *M.incognita* because the nematode successfully established itself on these clones and the difference in mean dry matter of the inoculated plants significantly lower than that of the inoculated plants.T65/7 and ICSI were rated as tolerant. The nematode was also able to establish itself successfully on the clones with the difference in mean dry matter of the inoculated higher than that of the uninoculated i.e. the clones suffer no statistically significant loss in dry matter.

The resistant clones are LCTEEN, T12/11 and AMAZ 15-15. These clones showed good root development in spute of *M.incognita* infection. The galls were fine and root hairs not destroyed. They showed comparatively healthy shoot growth for both inoculated and Meloidogyne-free plants. The nematode was unable to reproduce efficiently on these clones and they showed no statistically significant loss in dry matter both in the green house and in the nursery.

When visually rated F3 Amazon compared favourably with the best five clones LCTEEN, T12/11, AMAZ 15-15, T65/7 and ICSI (Table 1), but was inferior in root growth to T65/7, LCTEEN and T12/22. Amelonado was inferior to all the clones that were evaluated.

References

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Table 1: Reaction of Theobroma cacao clones to *M.incignita*

Clones	Gall Index		No of Nematode/250ml soil		Rating
	A	B	A	B	
MXC67	3.0	3.0	6745	6750	Susceptible
T86/2	3.0	3.0	7665	7650	Susceptible
PA150	3.0	3.0	8433	8450	Susceptible
LCTEEN	1.0	1.0	4870	4850	Resistant
T12/11	2.0	2.0	4960	4950	Resistant
T101/11	3.0	3.0	11175	11180	Susceptible
T53/5	3.0	3.0	6010	6012	Susceptible
T65/7	3.0	3.0	9659	9650	Tolerant
ICSI	3.0	3.0	7250	7275	Tolerant
AMAZ15-15	2.0	2.0	5012	5002	Resistant
F3 AMAZON	3.0	3.0	8113	8100	Susceptible
AMELONADO	3.0	3.0	14100	14100	Susceptible

Table 2: Effect of *Meloidogyne incognita* on cacao clones 24 weeks after planting

Clones	Treatment	Plant height (cm)		Stem girth (cm)		Fresh root Weight (g)		Fresh shoot weight (g)		Dry matter (g)	
		A	B	A	B	A	B	A	B	A	B
MXC67	0	58.9	63.4	1.5	1.6	34.7	39.7	45.8	53.5	43.2	50.7
	1000	58.2	62.7	1.2*	1.3*	21.0*	26.0*	38.0*	43.0*	32.6*	34.3*
T86/2	0	49.8	54.3	1.4	1.6	32.2	37.2	32.2	37.2	41.2	41.6
	1000	56.0	60.6*	1.4*	1.5*	29.1*	33.8*	29.1*	33.8*	34.7*	32.6*
PA150	0	70.1	74.6	1.5	1.6	39.0	44.0	48.3	53.5	42.5	50.0
	1000	56.7*	61.2*	1.2*	1.3*	29.2*	43.2*	32.7*	37.7*	31.0*	38.5*
LCTEEN	0	53.9	58.4	1.3	1.4	29.6	26.7	29.6	34.6	35.9	43.3
	1000	62.8*	67.3*	1.5*	1.6*	38.4*	37.1*	38.4*	43.1*	36.6	44.2
T12/11	0	54.5	59.0	1.5	1.5	21.4	26.7	43.5	48.5	36.1	43.6
	1000	58.8*	60.8*	1.6*	1.7*	32.1*	37.1*	57.1*	62.2*	48.0*	55.5*
T101/11	0	63.8	68.3	1.4	1.5	40.63	45.6	58.2	58.2	41.9	48.0
	1000	57.8*	62.3*	1.2*	1.2*	6.8	41.8	46.1*	46.1*	38.0*	41.8*
T53/5	0	52.1	55.4	1.4	1.5	34.02	39.2	50.2	55.2	38.8	46.4
	1000	58.7*	63.2*	1.5	1.6	26.5*	31.6*	39.9*	44.9*	27.4*	34.9*
T65/7	0	43.4	47.8	1.0	1.1	24.2	29.2	23.0	28.0	24.0	31.5
	1000	43.8	48.3	1.2*	1.3*	25.2*	30.2*	28.8*	33.9*	25.5	34.0
ICSI	0	49.5	54.0	1.4	1.5	18.3	23.3	29.5	34.5	27.6	35.0
	1000	61.3*	65.8*	1.5*	1.6*	20.6*	25.6*	49.8*	54.8*	28.4	35.9
AMAZ15-15	0	32.7	37.2	1.0	1.1	10.5	15.5	11.7	16.8	13.8	20.0
	1000	46.0*	50.5*	1.1	1.1	20.1*	25.1*	27.9*	32.9*	24.7*	32.2*
F3 AMAZON	0	52.3	56.8	1.3	1.4	17.8	22.8	34.9	40.0	25.0	32.6
	1000	43.0*	47.5*	1.2*	1.3*	12.8*	17.8*	28.6*	33.6*	17.4*	24.7*
AMELONADO	0	44.3	48.8	1.1	1.2	17.4	22.4	24.2	29.2	18.0	24.5
	1000	34.7*	39.2*	1.0*	1.1	11.8	16.8	15.0*	20.0*	11.4*	18.9*

A = Greenhouse
B = Nursery

Table 3: Growth response of ten clones of Theobroma cacao seedlings 24 weeks after inoculation with *M.incognita* eggs

CLONES	GREENHOUSE EXPERIMENT						NURSERY EXPERIMENT					
	Plant Height (cm)	Number of leaf	Stem girth (cm)	Fresh root weight (g)	Fresh leaf weight (g)	Fresh stem weight (g)	Plant Height (cm)	Number of leaf	Stem girth (cm)	Fresh leaf weight (g)	Fresh leaf weight (g)	Fresh stem weight (g)
MXC67	38.2ab	27.5c	1.2cd	21.0bc	28.2abc	38.0bcd	62.7ab	31.3cd	1.3bcd	26.0bcd	33.2abc	53.8ab
PA150	36.1abc	30.0bc	1.4abc	29.1abc	23.6bc	30.1cd	60.6abc	34.0bcd	1.5abc	33.8abc	28.6bc	39.1bcd
LCTEEN	36.7abc	22.5cd	1.2cd	29.2abc	34.1ab	32.7bcd	61.2abc	23.3de	1.3bcd	43.2abc	39.1ab	53.3ab
T12/11	42.8a	39.8ab	1.5ab	38.4a	35.4ab	38.9bcd	67.3a	43.8ab	1.6ab	43.1a	40.4ab	45.2abc d
T12/11	38.8ab	30.8bc	1.6a	32.1ab	36.7ab	57.1a	60.8abc	34.0bc	1.7a.	37.1ab	41.7ab	48.5ab
T101/15	37.8ab	23.0cd	1.2cd	36.8a	34.7ab	46.1abc	62.3abc	26.8cde	1.2cd	41.8a	39.7ab	58.2a
T53/5	38.7ab	22.3cd	1.5ab	26.5abc	24.5bc	39.9bcd	63.2ab	26.3cde	1.6ab	31.6abc	30.0abc	55.2ab
T65/7	43.8ab	23.8cd	1.2cd	25.2abc	25.6abc	28.8cde	48.3cd	27.5cde	1.3cd	30.3abc	30.1abc	28.0de
ICSI	41.3a	21.0cd	1.5ab	20.6bcd	38.1a	49.8ab	65.8a	25.0cde	1.6ab	25.9bcd	43.1a	34.5cd
AMAZ15-15	46.0bcd	43.0a	1.1d	20.1bcd	27.5abc	27.9de	50.5bc	25.1bcd	1.1d	25.1bcd	32.5abc	16. 8c
F3	34.7cd	14.8	1.2cd	12.8d	18.7cd	28.6cde	46.5cd	17.8d	1.3bcd	17.8d	23.7cd	39.9bcd
AMALENADO	39.2d	15.0d	1.0d	11.8d	8.6d	15.0c	39.2d	16.8d	1.1d	16.8d	13.6d	29.2de

Values are means of 4 replications
Means followed by the same alphabetical letter(s) in each column do not differ significantly from each other at p=0.05 based on Duncan's Multiple Range Test (DMRT)

Table 4: Percentage reduction or increase in some growth parameters of cocoa varieties due to inoculation of *M.incognita* in the nursery

Clones	Percentage reduction/increase in growth parameter							
	Plant Height	Number of leaf	Stem girth	Fresh root weight	Fresh leaf weight	Fresh stem weight	Total dry matter	Degree of Resistance Rating
MXC67	12NS	34.6*	14.2*	34.6*	19.6*	28.1*	32.3*	Susceptible
T86/2	+11.6NS	15..0NS	34.4NS	9.1NS	18.1NS	22.0*	21.3*	Susceptible
PA150	18.0*	33.6*	17.7*	22.4*	29.6*	10.3*	24.9*	Susceptible
LCTEEN	+15.3*	+19.9*	+18.5*	+24.7*	2.7Ns	+7.7NS	1.1NS	Resistant
T12/11	+2.8N.S	+3.3N.S	+7.8NS	+39.2*	+28.1NS	5.9NS	+27.2*	Resistant
T101/11	8.8*	0.2NS	18.0*	8.8NS	12.2*	10.1*	5.1*	Susceptible
T53/5	+14.1*	9.5*	+3.3Ns	19.6*	18.7*	17.4*	24.7*	Susceptible
T65/7	+1.1NS	+19.6NS	+21.9*	+3.3*	+21.2*	15.5*	+8.0	Tolerant
ICSI	+21.8*	+13.6*	+9.0*	+10.0*	+59.2*	+30.2*	+2.4NS	Tolerant
AMAZ15-15	+35.8*	+80.8*	0.NS	+0.6NS	+95.8*	+46.7*	+68.8*	Resistant
F3 AMAZON	+1.3Ns	15.8NS	0.1NS	0.2NS	15.7NS	27.5NS	24.2*	Susceptible
AMELONADO	19.6*	26.9*	10.0*	24.0*	33.3*	37.0*	22.5*	Susceptible

Table 5: Percentage reduction or increase in some growth parameters of cocoa varieties due to inoculation of *M.incognita* in the greenhouse

Clones	Percentage reduction/increase in growth parameter							
	Plant Height	Number of leaf	Stem girth	Fresh root weight	Fresh leaf weight	Fresh stem weight	Total dry matter	Degree of Resistance Rating
MXC67	13NS	37.1*	15.2*	65.5*	21.6*	31.5*	37.8*	Susceptible
T86/2	+12.6NS	16.7NS	+3.7NS	9.7NS	11.9NS	25.5*	24.6*	Susceptible
PA150	19.2*	32.3*	18.9*	25.2*	32.3*	11.7*	15.4*	Susceptible
LCTEEN	+16.6*	+22.3*	+20.0*	29.7*	3.0NS	+8.9NS	+2.0NS	Resistant
T12/11	+7.8NS	+6.0NS	+4.7NS	+49.9*	+31.1*	6.6NS	32.9*	Resistant
T101/11	9.4*	20.0*	15.7*	9.4NS	13.4*	11.4*	7.8*	Susceptible
T53/5	+12.8*	11.0*	+1.3NS	22.6*	20.5*	23.1*	29.4*	Susceptible
T65/7	+0.9NS	+25.0NS	+24.2*	+3.9*	+25.3*	16.4*	+10.6	Tolerant
ICSI	+23.8*	+16.7*	+9.6*	+12.6*	+69.2*	+36.1*	+2.6NS	Tolerant
AMAZ15-15	+40.5*	+95.5*	+10.0NS	+92.3*	+136.9*	+60.3*	+70.0*	Resistant
F3 AMAZON	+1.4NS	19.2NS	5.5*	0.4NS	23.5*	32.9NS	30.0*	Susceptible
AMELONADO	21.6*	31.8*	11.5*	32.0*	39.4*	48.2*	33.0*	Susceptible

Increase/Reduction significant at P<0.05
+Increase over control.
NS Not significantly different

Table 6: Resistance Rating of twelve clones of cocoa using the quantitative scheme for assigning crop varieties into resistance categories based on dry matter reproduction factor and gall index (Afolami, 2000).

	GREENHOUSE EXPERIMENT							NURSERY EXPERIMENT							
Clones	Mean no of Gall	Gall Index (I)	Rep Factor (R)	Mean Dry Weight of Seedlings			Resistance Categories	Mean No of Gall	Gall Index (I)	Rep Factor (R)	Mean Dry Weight of Seedlings			Resistance Categories	Remarks
				A	B	A-B					A	B	A-B		
MXC67	27.5	3.0	1.35	28.7	43.2	-14.5*	Susceptible	28.0	3.0	1.36	3.43	50.7	-16.4*	Susceptible	Consistent
T86/2	27.3	3.0	1.33	25.7	34.1	-8.4*	Susceptible	27.3	3.0	1.48	3.27	41.8	-8.9*	Susceptible	Consistent
PA150	27.0	3.0	1.09	31.0	38.7	-7.7*	Susceptible	26.0	3.0	1.72	3.75	50.0	-12.3*	Susceptible	Consistent
LCTEEN	2.0	1.0	0.97	36.6	35.9	0.7NS	Resistant	1.8	1.0	0.90	4.42	44.0	0.2NS	Resistant	Consistent
T12/11	3.0	2.0	0.99	48.0	36.1	11.9*	Resistant	2.8	2.0	0.99	5.35	43.6	11.7*	Resistant	Consistent
T101/11	24.3	3.0	2.24	38.1	41.3	-3.2*	Susceptible	23.8	3.0	2.28	4.55	48.0	-2.4*	Susceptible	Consistent
T53/5	24.8	3.0	1.20	27.4	38.8	-11.4*	Susceptible	24.5	3.0	1.20	3.49	46.3	-11.4*	Susceptible	Consistent
T65/7	20.3	3.0	1.93	26.5	24.0	-2.5*	Tolerant	25.5	3.0	1.94	3.40	31.5	4.5*	Tolerant	Consistent
ICSI	28.6	3.0	1.45	28.4	27.6	0.8NS	Tolerant	28.6	3.0	1.46	3.59	35.0	0.9NS	Tolerant	Consistent
AMAZ15-15	2.5	2.0	1.00	24.7	13.8	10.9*	Resistant	2.3	2.0	1.00	3.22	20.8	11.4*	Resistant	Consistent
F3 AMAZON	15.8	3.0	1.62	17.4	25.0	-7.6*	Susceptible	15.3	3.0	1.04	2.47	32.6	-7.9*	Susceptible	Consistent
AMELONADO	18.3	3.0	2.02	11.4	17.0	-5.6*	Susceptible	18.4	3.0	2.04	1.90	24.5	-5.5*	Susceptible	Consistent

GI = Gall index where 1-1-2galls; 2 =3 – 10galls; 3=11-30galls; 4 = 31 – 100galls; 5=>100galls (after Taylor and Sasser, 1978)
R = Nematode Reproduction Factor = Final number of juveniles and eggs (P_r)/initial inoculums (P_r)
* = Statistically Significant Difference (P ≤0.05)
NS = Not significant
A = Inoculated
B = Uninoculated

Experimental Title: Comparative studies of the relative efficiency of different media for induction of cocoa somatic embryos.
(Muyiwa,A.A.)

Introduction

The success of plant tissue culture relies on the controlled culture vessel environment and to be more exact on the constituents of the nutrient medium and the resultant high humidity. Nutritional requirement for the optimal growth of a tissue in vitro may vary with the species. Tissue from different parts of a plant may have different requirements for satisfactory growth (Murashige and Skoog. 1962). As such no single medium can be said to be entirely satisfactory for all types of tissues and organs. Some of the earlier plants tissue culture media e.g. root culture medium of whites (1943) and callus of Gutharet (1939) were developed from nutrient solutions previously used for whole plant culture. White evolved the medium from Usperkia's media formations. Few media are initiated based on results of soil composition analysis; while other is based on either plant constituent analysis or modification of these. Today there is however as many media formations as well as successfully growth plant species in vitro. Pence, (1989) and (Esan, 1992) reviewed the progress work from the report of the status of in vitro regeneration of cacao Evans (1951) to the most recent field establishment trial of in vitro plants cacao. The choice used, and the further development of nutrient media meet the requirements of cacao cells protoplast, tissues, and organs. Thus this work was designed to:

(a) Improve on the development of a satisfactory non toxic, environmentally and biologically degradable tissue culture nutrient medium for cocoa tissues.

(b) To compare and evaluate the regenerative potentials of cocoa floral cultured on the natural medium relative to the synthetic medium developed by the Pennsylvania State University (P.S.U) U.S.A.

(c) Investigate the utilization of locally available materials as medium component.

Materials and Method:

The materials used for this experiment were sought for at the Institute's Cocoa plots. Six clones used routinely were used for this experiment namely T86/45, scavina 12.0.p T87/79, T85/799, T12/1223 and T79/379. The synthetic cocoa tissue culture medium developed by the Pennsylvania state University, USA was used as the standard reference medium for this investigation while the natural inorganic components explored were; Trona, a sesquicarbonate of sodium; earthworm cast and lagoon water, the standard reference medium which is the primary callus growth medium P.C.S. comprised of DKW macro' A 100m/s, DKW macro' B
100m/s, DKW micro (1000x) 10m/s, DKW vitamins, 1ml. Glucose 20g, Glutamine 25mg, myo inositol 100mg, 2,4-D/mg/ml stock 2ml, Thidiazucon. 1mg/ml/stock 2ml, Phytagel 2.g. Lagoon water was procured in Lagos with the beach sand and allowed to stand and sediment for 2 weeks before use. Earthworm cast was collected in CRIN cocoa/plantain and banana plots while the Trona was procured at a local market in Ibadan. The earthworm cast was pulverized into very fine powdery form using a high speed and dry blending electric motor. Samples were stored in screw cap bottled and kept desiccators. Impure form of trona was procured and stored in desiccators before use. The macro A, B and micro 1000x of the standard reference medium were preplaced with each of the natural alternatives explored. 1 litre media preparation was made for each, the pH was adjusted to 5.7.

Surface sterilization and flower dissection

Unopened immature flower of medium size with the base of filaments attached were collected

early in the morning in a clean McCartney bottle containing distilled water. The flower buds were then surfaced sterilized in 4% w/v calcium hypochlorite solution in a sterile plastic container for twenty minutes by gently rocking the tube back and forth every five minutes while assuring contact of the hypochlorite solution with the flower buds. The hypochlorite solution was removed by re-rinsing thrice with sterile distilled water by inverting the tubes several times. With forceps, flower buds were transferred to a sterile Petri dish inside the laminar flow and closed to prevent desiccation.

The flower buds were sliced across at a position approximately one-third of the flower length from the base of filament using scalpel no.11 blade. Staminodes and petal tissues were extracted through the cut end and with forceps, were transferred into Petri dishes containing 25-30ml of the primary calling growth medium and the explored alternative media. Separating any fused staminodes and petal explants and distributing evenly on the surface of the media without immersion. Petri dishes were sealed with parafilm Labeled and kept in a box. Cultures were maintained in the dark at 25-30c for fourteen days. All explants were re-culture onto fresh Primary Callus growth Trona, Lagoon water, and earthworm cast based media at fourteen days interval.

Results

Callus formations were observed on all the clones cultured on both the synthetic and natural medium. On standard reference medium. The callus formation was whitish and compact at 24weeks, somatic embryos and root formation were also observed. The callus formation on the primary callus growth media (P.C.G standard reference medium) and lagoon water based medium equaled in effective characteristic for the Trona based medium; Torpedo shaped embryogenic callus was observed at 24weeks. On Earthworm cast based medium, creamish to brownish friable callus was observed.

Genotypic variation existed among the different clones cultured. Clone T86/45 and T86/799 recorded the highest regenerative potential. Followed by T87/79 and T79/399 which produced friable callus. T12/1223 and scavina+20.p callus formation were relatively the poorest. Though somatic embryos were not evident on the natural based medium, they could still be achieved in future.

Conclusion

The performance of cocoa floral part on the natural alternative medium explored showed that, the natural alternative medium could be used in cocoa tissue culture studies. The callus formation is both the natural alternative and synthetic media equaled in effectiveness characteristics. This confirms the efficacy of the natural alternative medium for use as substitute in cocoa tissue culture. However the floral explants could not grow beyond the callus formation as compared to the synthetic medium.

Formation observed equaled in effectiveness characteristics with the synthetic medium also confirmed natural alternative efficacy as medium substitute for cocoa. The aim of this is to improve on the development of a satisfactory non toxic tissue culture nutrient medium that has non been perfected yet as floral explants could not go beyond callus formation compare to the synthetic medium. Future efforts would be directed towards achieving this.

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FIGURES AND TABLES

Table 1: Analysis of Variance of Cocoa Explants to P.C.G Medium

SV	DF	NCE	NCOE	NSE	MSE
Replications	2	2.39ns	0.50ns	1.17ns	0.02
Clones	5	3.39.16	83.83	74.13	4.10
Error	16	1.5.9	1.83	0.50	0.01

SV:- Source of variation

DF:- Difference

NCE:- Number of callus explants

NCOE:-Number of contaminate explants

NSE:- Number of surviving explants

MSE:- Mean of surviving explants

Table 2: Mean Separaton of Treatment (Clones) On P.C.G. Medium

CLONES	NCE	NSE	NSE	MSE
T86/45	30.00a	15.33a	15.00b	3.00a
T85/799	30.00a	7.33c	14.33b	3.00a
T12/1223	1.00c	0.67c	17.33a	0.00d
Sca 12 0.p	18.00b	5.33d	4.67d	1.00c
T87/799	19.00b	5.33d	5.33d	2.00b
T79/379	19.33b	10.00a	10.33c	2.00b

TABLE 3: Mean Separation (Lsd) Of Treatment (Clones) On Lagoon Water Supplemented Medium

CLONES	NCE	NCOE	NSE	MSE
T85/45	19.33a	10.67cd	10.00a	3.00a
T85/799	15.33b	14.67b	8.33b	3.00a
T12/1223	4.33c	15.67b	1.00d	0.67c
Sca 12.0p	0.001	20.00a	0.00d	0.00d
T87/799	16.67c	9.33d	5.00c	2.00b
T79/379	8.00d	12.00c	3.67c	2.00b

Table 4: Anova of Response of Cocoa Explants to Lagoon Water Supplemented Medium

SV	DF	NCE	NCOE	NSE	MSE
Replications	**2**	**0.72ns**	**0.62ns**	**0.17ns**	**0.6**
Clones	**5**	**150.72**	**45.39**	**145.03**	**4.49**
Error	**10**	**0.72**	**0.72**	**0.70**	**0.65**

Xx Signification deficient at p0.001

Table 5: Mean Separation (Isd) of Treatment (Clones) on Trone

CLONES	NCE	NCOE	NSE	MSE
T86/45	20.33A	16.33B	5.00A	3.00A
T85/799	19.67a	15.33b	4.33a	2.97a
T12/1223	0.07c	20.00a	0.33c	0.33d
Sca 120p	19.33a	10.33	5.33	1.00c
T87/799	5.00b	15.00b	2.33b	2.00b
T79/379	19.00a	16.67b	2.67b	1.10b

Table 6: Anova of Response Of Cocoa Explants On Trona Supplemented Medium

SV	DF	NCE	NCOE	NSE	MSE
Replications	2	0.17ns	0. .39ns	0.67ns	0.15ns
Clones	5	230.6	29.62	10.93	3.39
Error	10	2.33	0.79	0.40	0.01

Table 7: Mean Separation (Isd) of Treatment (Clones on Trone on Earthwsorm Cast Supplement Medium

CLONES	NCE	NCOE	NSE	MSE
T86/45	20.33A	16.33B	5.00A	3.00A
T85/799	19.67a	15.33b	4.33a	2.97a
T12/1223	0.07c	20.00a	0.33c	0.33d
Sca 120p	19.33a	10.33	5.33	1.00c
T87/799	5.00b	15.00b	2.33b	2.00b
T79/379	19.00a	16.67b	2.67b	1.10b

Table 8: Anova of Response of Cocoa Explants to Earthwom Cast Supplemented Medium

SV	DF	NCE	NCOE	NSE	MSE
Replications	2	0.72ns	0. 22ns	0.22ns	0.06ns
Clones	5	49.16***	87.52	13.52***	2.76
Error	10	0.62	0.82	0.22	0.17

A figure with the same letter in columns is not significantly at $p<0.05$
*** Significantly different at $p<0.001$
NS:- Not significantly different
DF:- Difference
NCE:- Number of callus explants
NCOE:- Number of contaminated explants
MSE:- Mean of surviving explants

Figures with the same letters in a column are not significantly different at 5% probability level.
*** Significantly different
SV:- Source of variation
DF:- Difference
NCE:- Number of callus explants
NCOE:- Number of contaminated explants
NSEW:- Number of providing explants
MSE:- Mean of surviving explants

Experimental Title: Breeding for early maturing or precocious cocoa hybrids (Adenuga, O. O., Adewale, B. D. and Adeigbe, O. O.)
Objectives: The objective of the study was to obtain cocoa hybrids with reasonably short gestation period.

Justification: Cocoa is a crop with long gestation period. In most cases, it bears fruit about four years or even more after establishment in the field. An evaluation of some hybrids at CRIN Headquarters led to the identification of some 27 genotypes which attained fruiting between 18 and 24 months after field establishment. Pod production among these 27 genotypes ranged between 1 and 18 pods per individual tree at about 30 months of field establishment. Improvement on these findings will make early maturing materials available for farmers.

Materials and method: In an experiment, seven promising genotypes among these 27 were crossed in a 7x7 half diallel design in which each of the 7 was mated to everyone else including itself. The progenies thus generated were raised in the nursery and transferred to the field at CRIN Headquarters in Ibadan in June 2011. The experimental layout is RCBD with 3 replications. The collection of juvenile data on the field commenced at 3 months after field establishment and is ongoing, hence result is not yet ready from this experiment.

Conclusion: The work is ongoing. The final and derivative deduction shall be made at the end of the experiment.

Constraint: Inadequate and untimely release of fund. The irrigation of the field was personally funded. Hence the established plants were adversely affected by the harsh weather during the dry season between December 2011 and April 2012. At present, there is no fund available for the establishment of the second field which

should be established at Owena in Ondo State, as the experiment is a multilocational trial.
The other two experiments that were designed alongside this one could not proceed further, owing to inadequacy of fund.
Outlook: The research is ongoing.

Experimental Title: Occurrence of ochratoxin A in Nigerian Kola nuts "ready for sale" cocoa beans (Dongo L.N.[1], Bandyopadhyay R [2], Kurma M[2], and Ojiambo P.[2)]

Introduction:
The increasing occurrence of mycotoxins (secondary metabolites of fungal origin) in agricultural commodities and the subsequent impact on consumer health as well as on national and global trade has attracted the attention of the scientific community in both the developed and developing countries. Ochratoxin A (OTA), a mycotoxin that was first isolated in 1965 in south Africa from a strain of *Aspergillus ochraceus* (Merwe der et al., 1965) usually occurs as a trace contaminant in many agricultural products. Since its discovery, OTA had been reported to be produced by a few molds belonging to the *Aspergillus and Penicillium genera including A. albertensis, A. Auricomus, A. allianceus, A. ostianus, A. Scleriorum, A. melleus, A. wentii and P. verrucosum* (*Rizzo et al*., 2002). These fungi are ubiquitous and can occur in tropical and temperate climates. Growth of the mold and production of the OTA are dependent upon a number of factors such as the amount of inoculums, substrate, water activity, moisture content, temperature, incubation time and humidity during the growth, harvesting, processing and subsequent drying and storage of the crop. Nigeria has a topical climate with all year round high ambient temperature and relative humidity that provide optimal condition for the growth of these toxigenic and subsequent production of OTA. The Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment concluded that OTA is a genotoxic carcinogen and advised that OTA levels in food should be reduced to the lowest level that is technologically achievable (COT, 1997).
It therefore becomes imperative that efforts should be made with regards to research and prevention measures to reduce OTA content in

cocoa beans as much as possible pending the establishment of maximum limits.
Several investigators have reported the natural contamination of OTA is trace quantities (ng-ug) in a variety of food and feedstuffs from many countries. In Nigeria, however, there are few reports on the possible OTA contamination of cocoa beans and products (Dongo et al., 2006, Aroyeun et al., 2006). Due to the importance of cocoa in Nigeria as second largest foreign exchange earner, research towards the improvement of cocoa bean quality with special emphasis on OTA is of high importance.
This study therefore was initiated to investigate the natural occurrence and levels of OTA in "ready for sale" cocoa beans in Nigeria with a view of developing intervention strategies necessary to possibly drying and bagging.

Materials and methods

Sampling: A total of 59 "ready for sale" cocoa bean samples were collected from cocoa farmers (59) during a survey of three cocoa producing states in Nigeria VIZ: Ondo, Cross Rivers, and Edo States. Ten cocoa bean samples were from 10 cocoa farmers in Ondo State, while 21 and 28 were from Edo and Cross River States respectively. The farmers were selected based on the availability and their readiness to supply cocoa beans. The sampled areas within the three states are shown in Fig.

Extraction of Cocoa Beans Extracts

The cocoa beans extracts were extracted following the procedure of ICRISAT (40).
.5g of cocoa beans was ground using a blender. This was triturated in 25mls of 70% methanol containing 0.5% potassium chloride until it was thoroughly ground. The suspension in a conical flask was homogenized with an orbital shaker at 300rpms for 30 minutes, and then filtered through whatman No.1. The filtrates were stored in glass vials at 4^{o}C until required.

OTA Analysis: Analysis of OTA was performed on all samples according to the OTA indirect competitive ELISA method of ICRISAT (**http//www.afltoxin.info/elisa1.htm**) with slight modifications.

Preparation of Ochratoxin A Standard Stock Solution

Ochratoxin A Standard (1mg powder) purchased from sigma (St.Louis, MO, USA) was prepared by dissolving 1mg powder in 10mls of Benzene: Acetic acid 99(v/v) (41). One milliliter of 10µg/ml was calibrated spectophometrically at 333 nm using the value 5550 1 mol^{-1} cm^{-1} for molar absorptivity. After calibration of the OTA solution, an exact volume was evaporated under the fume hood. The residue was redissolved in methanol to get 0.25µg/ml which served as stock solution. Further dilutions were made from the stock solution
(stored at 4^{o}C) when needed.

Statistical Analysis

Processing of the data was carried out by Statistical package for social sciences (SPSS). A non-parametric procedure (median test) was used in order to eliminate difficulties caused by heterogeneous data distribution. For statistical comparison of contamination rates, x2 test was applied within the three states.

Results and Discussions

Recovery Experiment

The recovery values of OTA from spiked uncontaminated cocoa bean extracts averaged 87% as summarized in Table 1. The range of the test was 0.02-0.18µg/kg with a detection limit of 0.01µg/kg.

OTA Analysis

Table 2 shows the results obtained from the OTA analysis of 59 "ready for sale" cocoa beans from Ondo. Cross Rivers and Edo States of Nigeria. Out of the 59 cocoa bean samples tested for OTA contamination, 54 samples contained detectable amounts of OTA (91.53%).
OTA was detected in the majority of the analyzed samples from Edo State (20/21) at

levels ranging from 1.01 to 200.8 ug/kg, and the mean value of the overall samples was over 34µ/kg. The most contaminated samples were from Owan East Local Government Area (LGA) of the state. Among the cocoa bean samples from Ondo State only 8 out of 10 were positive with an average OTA content of 37.1 and only 1 sample presenting more than 100µg/kg of OTA. Twenty six out of 28 cocoa bean samples from Cross Rivers State were positive for OTA with an average value of 40.37µg/kg. 22 of the samples had OTA levels less than 50µg/kg while 4 had values higher than this. The highest OTA level (277.48) was detected in 1 sample from Etung LGA of the state. OTA has been detected in many food crops above detection limits of 0.01µg/kg. 57% of 6476 food samples were reported to be OTA contaminated (Wolff. *et al.* 2000) while 22% of Italian marketed cocoa products were contaminated above detection limits of 0.01µg/kg (44). Ochratoxin A was detected in cocoa bean at levels from 0.1-3µg/kg, the mean concentration being 0.45µg/kg; only one sample exceeded 2µg/kg.

The frequency distribution patterns over different levels of OTA contamination are given in figure (2a-c) for the cocoa beans from Ondo, Cross Rivers and Edo States. Figure 2a shows that cocoa bean samples from Cross Rivers State with very high levels (250-300 µg/kg) were just one. Over 80% of the samples had OTA levels within the range 1-50µg/kg. For cocoa bean samples from Ondo State (Fig.2b), 88% had OTA levels within the range 1-5µg/kg. One cocoa bean sample from Edo State had very high OTA level (200-250µg/kg) while 80% had OTA levels within 1-50µg/kg. Figure 3 shows the comparison of the incidences of OTA contamination for the three states. Over 40% of the samples from Cross Rivers State had OTA levels lower than 50µg/kg and samples with high levels (>250µg/kg) were very exceptional. Only about 30% of the cocoa bean samples from Edo State showed values lower than 50µg/kg and about 2% of the samples showed OTA levels >200µg/kg. For cocoa bean samples from Ondo State, only about 13% of the samples showed values lower than 50µg/kg, whereas only 2% samples showed OTA levels over 100µg/kg. The box plots showing the distribution in terms of median, maximum and minimum values of the positive samples in each state are shown in Figure 4. The OTA level of cocoa bean samples from Cross Rivers State show a much higher dispersion than the other two states. It further shows that OTA levels of cocoa bean samples from Edo State fall within the median. The results of the median test and x2 test performed on the cocoa bean samples (Table 2) show that there were no significant differences among the OTA values of cocoa bean samples from the three different states.

The results showed that "ready for sale" cocoa beans from Edo, Cross River, and Ondo States of Nigeria are contaminated with OTA. However, in terms of levels of OTA and mean values, cocoa bean samples from Edo State are less contaminated than the cocoa bean samples from the other two states. This could be attributed to the prevailing climatic conditions in those states with respect to harvesting and drying. The three states (Ondo, Cross Rivers and Edo) fall within the humid forest zone of Nigeria that experience on the average 258.77mm amount of rainfall, 61-95% relative humidity and 22.4-30.3^{o}C of temperature during the peak harvesting season (September-December). These conditions favour mold development and subsequent production of OTA.

This result calls for future research on the OTA levels of cocoa beans from different ecologies in order to validate the dependence of OTA levels of cocoa beans from different ecologies in order to validate the dependence of OTA to climatic conditions. This will from the basis for developing intervention strategies towards reducing the levels of OTA in human and animal feeds. In conclusion, the quality of cocoa beans produced in Nigeria can be improved in spite of the fact that 91.52% of samples were above the detection limit of 0.01ug/kg. This can be achieved by putting in place effective weather

forecasting systems where by a farmer could be advised on when to harvest for proper drying of the fermented beans. Since sun drying may be a difficult task due to the high rainfall at the time of harvest, artificial dryers can be provided at subsidized rates for the cocoa farmers in Nigeria. Cocoa farmers should be educated on the need to observe good agronomic practices as these have been shown to have profound effect on mycotoxin contamination of crops in the field (Avantaggio et al., 2002)

Lastly, creation of awareness among the citizenry is very important as the problem posed to health and the economy is restricted among scientists. These control programs will ultimately boost international trade and offer long-term health benefits to the populace.

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Table 1. Recovery of ochratoxin A from spiked cocoa bean samples[a]

Added OTA (µg/kg)	Cocoa Beans (µg/kg)	Detected (%) b
0.02	0.015 ± 8.6	75±0.64
0.06	0.053±13.2	88±21.1
0.1	0.098±5.4	98 ±12.8
0.14	0.125±3.6	89±0.47
0.18	0.155±0.89	86±7.3

[a] Each sample was replicated thrice. Values are means ± SD
[b]Detected OTA (µg/kg) added OTA (µg/kg) x 100

Table 2: Occurrence of Ochratoxin A in "ready for sale cocoa beans" from different states

States	Positives/total	Mean of positives	Range[b] (µg/kg-1)
CRS[a]	26/28	40.37	1.88-277.47
ONDO	8/10	37.16	2.04-118.84
EDO	20/21	34.45	1.01-200.8
Overall	54/59	37.7	1.01-277.47

[a] Cross Rivers State

[b] Detection limit 0.01ug/kg Table 3 Median and x2 Tests of OTA levels in the cocoa
bean samples from three different States.

Median test		x^2 test			
States	Median	p<0.05	x^2	df	p
Cross Rivers	22.28	a	1.714	25	1.000
Edo	14.14	a	0.000	20	1.000
Ondo	35.46	a	0.8	8	1.000

TEA PROGRAMME

Experimental Title: Monitoring nutrient dynamics under tea germplasm plots at kusuku taraba state – a preliminary result (Daniel, M.A. and Ipinmoroti, R.R.)

Introduction:
Tea (Camellia sinesis L.) is one of the well established agricultural crops introduced into the Nigerian system some four decades ago with large commercial production limited on the Mamabilla plateau of Taraba State alone. This is due to the favourable climatic condition required for tea growth and production. The plateau is located between longitude 11°E – 12°E and latitude 6.5°N lying generally above 1500m above mean sea level with a temperate climate. Tea demand for soil nutrient is unusual with its specific character due to its rapid harvest which constitutes the economic yield made up of two leave and a bud (2 leaf + bud) usually harvested forth nightly. Hence maintaining the plants in a healthy condition for continuous production requires a lot input in the form of fertilizers to supplement the nutrients removed especially through harvest. Though is known that, all the nutrient elements except carbon, hydrogen and oxygen (Brady, 1999) are obtained from the atmosphere all other essential plant nutrients required by plant for growth and development are derived from the soil. Thus, for governing the soil nutrients that are liable to a lot of losses to ensure adequate productivity and continuous supply of planting materials from tea, an experiment was set up to monitor the nutrient dynamics for a period of five years.
Objective: To evaluate nutrient dynamic under tea germplasm toward solving the problems on declining yield, planting materials and tea harvest.

Materials and methods:
An experiment set up in the tea germplasm in Kusuku consisting of twenty four plots with different tea clones each plot measuring 4*4m^2.

The initial soil samples was collected, processed and analysed for baseline nutrient status data. Ten tea bushed were selected per plot and four were tagged for data collection. Leaf samples were collected in the first and second quarter and analysed.

Results and discussion:
The availability of nutrient in soil for readily plant uptake and continuous production is inevitable. The tea germplasm was established over forty years ago with twenty four different tea clones. Continuous selection for high yielding clones has been on-going and collection of planting materials year in year out couple with harvesting with no attention given to the nutritional aspect of the tea bushes has resulted to subsequent decline in production of planting material and tea leaves. A study conducted on the plots showed that, most of the basic nutrients required for optimum production were found to be below critical levels recommended for optimum growth of tea. The total N was found to be 1.7g/kg; available P 5mg/kg; and the exchangeable cations were 12.5, 5.50 and 10.5cmol/kg K, and Mg respectively. The C:N ratio of 12:10 was found to be low. This study was aimed at finding solution to the decling yield of planting material and tea harvest in the tea germplasm.

Table 1: Nutrient composition of tea leaves collected from the tea germplasm at Kusuku

Plots	Tea clones	Nutrient content				
		N	P	K %	Ca	Mg
1	Unknown					
2	367	2.52	1.10	0.30	0.30	0.30
3	370	3.30	1.20	0.40	0.20	0.3
4	19**	2.50	1.10	0.30	0.30	0.30
5	74	3.22	1.20	0.20	0.20	0.20
6	354	3.40	0.30	1.30	0.40	0.31
7	368	3.00	0.30	1.00	0.20	0.03
8	369	2.40	0.30	0.82	0.22	0.20
9	33	3.30	0.30	1.20	0.30	0.20
10	353	4.52	0.23	0.20	0.12	0.30
11	357	3.50	0.40	1.50	0.12	0.20
12	359	4.00	0.30	1.33	0.25	0.30
13	143*	4.11	0.30	1.33	0.25	0.30
14	14	3.11	0.28	1.20	0.22	0.11
15	238	4.05	0.30	0.25	0.32	0.30
16	25	4.55	0.30	2.22	0.20	0.11
17	108	5.56	0.27	2.50	0.25	0.20
18	363	3.11	0.30	0.40	0.25	0.30
19	35*	5.66	0.29	2.50	0.27	0.20
20	68***	4.11	0.33	1.33	0.30	0.32
21	61	2.62	0.30	1.05	0.40	0.40
22	228	3.22	0.30	1.10	0.45	0.44
23	236	5.21	0.31	1.70	0.28	0.31
24	318*	4.51	0.33	1.40	0.40	0.29

*Drought resistant and Slope clones;**Lowland humid area clones; ***Valley tolerant clones and best flavored commercial clones.

Experimental Title: Screening of local germplasm for resistance to Phytophthora pod rots (Ppr) (Otuonye, A.H.)

Introduction:
Phytophthora pod rot (Ppr) has been the primary fungal disease affecting cacao production worldwide. An estimated loss of about 44% of total global production every year has been incurred by the devastation of cacao ad its produce by the “black pod” pathogen. In West Africa, economic damage as high 100% have been obtained locally in some areas with virulent strain of *Phytophthora megakarya* (CABI Commodities, 2005). UNEP (2002) reports that in Nigeria yield losses with virulent strain of *Phytophthora* species are as high as ₦3,965.16 million. Although current cultural and chemical

control strategies exists, but they are either ineffective or too expensive for the 9% vast majority resource smallholder cocoa farmers to implement.
This has necessitated the urgent need for alternative control measures, preferably sustainable, cheap and easily integrated into existing management practices. Breeding for resistance against *Phytophthora* pod rot (Ppr) of cocoa has been acknowledged world wide to be the ultimate long-term solution.
It is therefore important after selecting cocoa germplasm with desired agronomic trait for breeding purposes from CRIN gene pool at the headquarters, that the materials be screened for resistance to *Phytophthora megakarya* pod rot, which is the preponderance black pod disease pathogen of cocoa in Nigeria.
The objective of the study was to evaluate the reactions of cocoa genotypes to inoculations by the fungal isolates and thereby identifying the resistant ones which could be advantageous to cocoa production.

Materials and methods:

Cocoa pods naturally infected with *Phytophthora megakarya* were harvested from the field. The morpho physical identification of this fungus infection of pods is the firmness from the infected pods to touch especially when pressed between fingers, the milky whitish downy mould sporulation and the characteristics sea week odor.
A pure culture of the cocoa black pod pathogen was isolated from the cocoa pod naturally infected by this fungus. Pathogenicity test with detached pod test spray method (DPT-SM) were carried out as reported by Iwaro et al.(2006) to obtain same symptoms observed in the field.
Mictoscopic examination of the pure culture of the fungus was carried out with x40, x100 objective lens, using Zesis Photomicroscope to observe the morphological characteristics as described by Stamp et al.(1990).
Fresh maturing leaves of cocoa twigs that are undergoing transformation from green to brown, selected from plots E4/1, E4/2 were harvested between 07.00 hours and 09.00hours. These leave samples were put in a transparent polythene and labeled properly and then brought to the laboratory. Leaf discs assay as reported by Nyasse et al. (1995), was used for the test or resistance of the *cacao* genotypes to the black pod fungus.
Analysis of data obtained was done using SAS package.

Results and Discussion:

The result obtained showed that T12/5, an upper Amazon cocoa with average disease rating index of 2.15 was better on preliminary comparison with the other test genotype, is in agreement with earlier findings on the sources of resistance to black pod disease of cacao (Soria, 1974; Iwaro et al., 1997b; Iwaro and Butler, 2001; Cilas et al., 1998 and Surujdeo et al., 2001). The upper Amazon Foresteros cacao materials from which clone T12/5 was developed from have been reported elsewhere by workers to show resistant to intermediate resistant level, in crosses involving Scavina 6 and 12 cacao germplasm materials with other cacao genotypes. This observation therefore explains the resistant level shown in clone T12/5 response to the influence of the isolate of *Phytophthora megakarya* in developing fairly low lesion number.

Conclusion: Clone T12/5, therefore may be included in breeding programme of the Institute for the development of high yielding and black pod disease resistant cocoa cultivars.

Outlook: Further screening of selected local cocoa genotypes will be carried out.
Constrain: Inadequate funding of research investigations, erratic electricity power supply and under equipped research laboratories.

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COFFEE PROGRAMME

Experimental Title: The termicidal effects of Chlorpyrifos 48 Ec, Endosulpan 35ec, Dichlorvos 1000ec and 600ec against termites in South-West Nigeria (*Asogwa,E.U.;. Okelana, F.A; Ndubuaku, T.C.N. and Mokwunye I.U**.)**

Introduction

Termites belong to the order isoptera. There are six families of termites, five of which are referred to as the lower or primitive termites. These five groups all possess intestinal protozoa, which help in the digestion of wood. The sixth family, the termitidae, including three-quarters of all living termites species. The Termitidae do not have symbiotic protozoans in their intestine but had other methods of dealing with digestion of wood (Malaka,1973).

Termites (Macrotermes bellicossus, Armitermes evuncifer, Nasutitermes sp. Microtemes sp etc) attack on economic crops is common in Nigeria plantations. With particles of soils, they construct foraging galleries from tree trunk base to the branches. These galleries are extensions of their subterranean nests. They move underneath, gnawing bark and stem tissues and their infestation is particularly severe during the dry season (October-March). Termites can cause damage to crops, buildings, pasture and forestry as well as to non-cellulose materials such as dam linings and electrical cables. Surface soil mounds can also interfere with ploughing and grazing. In Nigeria, farmers have long recognized termite damage to crops and other materials, and have realized that termite damage is greater in the dry season or when crops are just planted (Malaka 1972; 1983.)

In the past much emphasis was placed on Chlordane, Aldrin and Dieldrin for the control of termites because of their persistent effects in the soil (Harris, 1971). The effectiveness of using the organochloride insecticides (aldrin, DDT, Aldrex T) as a seed treatment, on seedlings, mature plants and for tree protection, is widely known. However much of this work comes from field trials carried out before the ban on organochlorines (Pearce, 1997). The following insecticides are reported to be currently in use against termites in modern commercial agriculture: Oftanol, Chlorpyrifos, Carbofuran and Permethrin, (Pearce, 1997). Most of the achievements recorded so far with these termicides have been outside the shores of this continent; hence the, main objective of this study is to investigate the activities of other chemical classes of insecticides outside the Organochlorines for their suitability for termite control in our local environment.

Materials and Methods

This research work was carried out in the Entomology laboratory of the Cocoa Research Institute of Nigeria, Ibadan at a temperature of 28± 3^0C and relative humidity 75 ±5%.

Collection of materials: Termite samples consisting of workers and soldiers of M. bellicosus and A. evuncifer were collected with a spatula into a tray from mound and trunks of dead woods at coffee experimental plots at CRIN Headquarters, Ibadan. The termites were conveyed to the laboratory for immediate bioassay test with the insecticides. The insecticides (Chlorpyrifos 48EC, Endosulfan 35EC, Dichlorvos 1000EC and Diazinon 600EC) were procured from the Agrochemical market at Ogunpa, Ibadan.

Bioassay test

The following tests were carried out on the termite caste (workers and soldiers) collected using different concentrations (0.0625%,0.125%, 0.25%, 0.05%) of the insecticides and an untreated control).

Tropical application test: Ten termites were picked from the collection tray into a petridish for each treatment. There were four treatments (0.063%, 0.125%, 0.25%, 0.05%) per insecticide and a no treatment (0%) control. Ten microlitres of each termiticide concentration was

applied directly onto the dorsal surface of the termites in each petridishes with the aid of a microsyringe (ie one microlitre/insect). Each treatment was replicated four times. The petridishes were perforated on the top to provide aeration and prevent suffocation of the test insects. Mortality counts were taken and recorded after every 20 minutes for 2hours (which was the maximum time period taken to achieve 100% mortality in over 90% of the petridishes). A termite was regarded as dead if it showed no signs of movement when touched lightly with a soft camel hairbrush or when it is lying flat on its back.

Residual contact action: This test was carried out with petridishes fitted with filter papers. The filter paper was drenched with 60 mictolitres of the termicide and allowed to air-dry for 5 minutes. Ten termites were placed in each of the petridishes to be in contact with the residue of the termicides. Each of the 4 treatments with a no treatment control was replicated four times. The petridishes were perforated on the top to provide aeration and prevent suffocation of the test insects. Mortality counts were taken every 20 minutes for 2hours using the same attributes of identifying a dead insect as earlier described.

Fumigant action test: The test was carried out using 500mls plastic containers (10cm x 10cm x 15cm) with cover and small muslin cloth bags measuring 7cm x 10cm. Ten termites were placed in each bag and the mouth tied with an extended rope with which it was lowered half way into the plastic container containing 2mls of the termiticide. The cups were covered immediately to allow the termites get in contact with the fumes of the various termiticide concentrations. Each of the 4 treatments and a no treatment control was replicated four times. Mortality count and recording were taken every 2hours after treatment using the same attributes of identifying a dead insect as earlier described.

Statistical analysis of the tests: The data obtained in all the bioassays were subjected to the analysis of variance. Means were separated using Duncan's Multiple Range Test in order to test the levels of significance.

Results

Table 1 shows the mean mortality rate of Chlorpyrifos on termite castes following topical, residual and fumigant action tests. There was no significant difference ($P>0.05$) among the topical and residual action treatment means for the worker caste, but all their treatment means significantly differed ($P<0.05$) from their control at 120 minutes after exposure (MAE). The mortality trend was not the same for the soldier caste, where most of the treatments gave low mortality rates, which differed significantly ($P<0.05$)from each other and their control. A mortality rate of over 50%, 70% and 90% was achieved within 20MAE following topical application on the worker caste at 0.125%, 0.25% and 0,5% treatment levels. The residual action test gave an overall high mortality of the worker caste than the topical application with 60%, 80% and 100% mortality rates within 20MAE at 0.125%, 0.25% and 0.5% treatment levels, respectively. The reverse was the case for the soldier caste, where the topical application came down with 40%, 60% and 70% mortality, respectively as against 30% recorded for the residual action test 120MAE at the same treatment levels. The insecticide had very low fumigant action on the termites. A maximum of 10% mortality was achieved following exposure of the termite case to the highest concentration (0.5%) of the insecticide. No mortalities were recorded in control petridishes throughout the exposure period.

The result of the mean mortality rate of Dichlorvos on termite castes following topical,

residual and fumigant action tests are shown in Table 2. The trend was the same for Chlorphyrifos with both topical and residual action test achieving 50% mortality rate on the worker caste at 0.25% treatment level 20MAE. There was no significant difference among the various treatments means of 0.125%, 0.25% and 0.5% concentrations at 120MAE; though they all differed significantly ($P<0.05$) from their control treatments. The residual applications achieved an overall higher mortality on the worker caste, than for the soldier caste. However, the soldier caste was seen to be more tolerant to the insecticide than the worker caste. No mortalities were recorded in control petridishes throughout the exposure period.

The mean mortality rates of Diazinon on termite castes following topical, residual and fumigant action tests are shown in Table 3. Both the topical and residual action tests achieved 50% mortality on the worker caste at 0.25% treatment levels within 20MAE. The mortality rates of the various treatment levels (0.125%), 025% ad 0.5%) showed no significant differences among themselves, but differed significantly ($P<0.05$) from their control treatments at 120MAE. Residual application gave a better kill of the worker caste, while higher mortality of the soldiers were recorded for the topical application than for the workers. The insecticide had no fumigant action on both termite castes 120MAE. No mortalities were recorded in control petridishes throughout the exposure period.

Table 4 shows the mean mortality rate of Endosulfan on termite castes following topical, residual and fumigant action tests. The topical and residual action tests at 0.25% treatment levels gave a 40% mortality of the worker caste 20MAE. At 120 MAE the mortality rates at 0.125%, 0.25% and 0,5% treatment levels showed no significant difference, but differed significantly ($P<0.05$) from their control. A higher mortality of the soldiers caste was recorded for the topical application, while residual application gave a better kill of the workers caste 120MAE. The workers were more vulnerable to the insecticide than the soldiers. The insecticide had no fumigant action on the termite castes. No mortalities were recorded in control petridishes throughout the exposure period.

Discussions

The relatively high mean mortality recorded for these termicides especially on the worker caste was in line with earlier report by Akhtar and Shahid (1991), which stated that Chlorpyrifos when applied around the stem of cotton plants at 1,600g of active ingredient per acre can be as effective as Aldrin at 400g a.i.per acre. Also Chlorpyrifos according to Cowie et al (1989) has been the major treatment in forestry and other crops in the past few years for the prevention of termite attack.

The worker and soldier castes were used for these tests because of their important roles of foraging and protection of the colony. There is a clear division of labour in termite colonies. The soldiers mainly defend the colonies from invading enemies while the workers build nests, forage galleries and take care of young termite stages (Amund et al.,1986). The soldier caste was noted to have shown lower mortality than the worker caste. The high death rate of the workers might be due to the fact that they were generally more active during foraging and thus more susceptible to the effects of the insecticide either by contact or systemic actions. The fact that the workers have a lower surface area and body weight than the soldiers might have also contributed to their higher vulnerability to the insecticides.

It is worthy of note that even though Chlorpyrifos gave an overall better kill of the termites than the other termiticides, there was no significant difference among the various treatments of the four insecticides tested. However, each of the insecticides could be

utilized effectively for termite control depending on affordability and availability. The application of these insecticides at 0.25% active ingredient is adjudge the best due to high mortality rate it achieved. Also the application at 0.25% will help to maintain cost-effectiveness of these insecticides and minimize environmental pollution, toxicity and phytotoxicity problems associated with pesticides. Finally, field trials with the insecticides should be carried out to confirm the high mean mortality achieved in these laboratory trials.

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FIGURES AND TBLES

Table 1: Mean mortality rate of Chlorpyrifos on termites (worker & Soldier castes) following topical, residual and fumigant action tests (n = 10/replicate)

	Exposure periods (minutes)											
	Worker caste						Soldier caste					
	20	40	60	80	100	120**	20	40	60	80	100	120**
% Conc.	% Mortality*											
Topical application												
0%	0	0	0	0	0	0b	0	0	0	0	0	0[d]
0.063%	30	60	70	100	100	100[a]	0	0	10	10	20	30[bc]
0.125%	50	80	90	100	100	100[a]	0	0	10	10	20	40[b]
0.25%	70	90	100	100	100	100[a]	0	10	30	50	60	60[a]
0.5%	90	100	100	100	100	100[a]	10	30	50	70	70	70[a]
Residual application												
0%	0	0	0	0	0	0[b]	0	0	0	0	0	0[d]
0.063%	30	70	90	100	100	100[a]	0	0	0	10	10	20[c]
0.125%	60	90	100	100	100	100[a]	0	0	10	20	20	30[bc]
0.25%	80	100	100	100	100	100[a]	0	0	20	20	30	30[bc]
0.5%	100	100	100	100	100	100[a]	0	10	20	20	30	30[bc]
Fumigant test* **												
0%	-	-	-	-	-	0[b]	-	-	-	-	-	0[d]
0.063%	-	-	-	-	-	0[b]	-	-	-	-	-	0[d]
0.125%	-	-	-	-	-	0[b]	-	-	-	-	-	0[d]
0.25%	-	-	-	-	-	10[a]	-	-	-	-	-	10[c]
0.5%	-	-	-	-	-	10[a]	-	-	-	-	-	10[c]

*Each value represents mean of four replicates
**Means followed by the same superscript within each method of application are not significantly different (P>0.05) according to Duncan's Multiple Range Test (DMRT).
***Mortality rate taken once 2hours after treatment

Table 2: Mean mortality rate of Dichlorvos on termites (worker & Soldier castes) following topical, residual and fumigant action tests (n = 10/replicate)

	Exposure periods (minutes)											
	Worker caste						Soldier caste					
	20	40	60	80	100	120**	20	40	60	80	100	120**
% Conc.	% Mortality*											
Topical application												
0%	0	0	0	0	0	0^{c}	0	0	0	0	0	0^{e}
0.063%	20	40	50	70	80	80^{a}	0	0	0	10	10	10^{cd}
0.125%	30	50	70	90	100	100^{a}	0	0	10	10	20	30^{bc}
0.25%	50	70	90	100	100	100^{a}	0	0	10	20	30	50^{a}
0.5%	70	90	100	100	100	100^{a}	10	30	50	50	60	60^{a}
Residual application												
0%	0	0	0	0	0	0^{c}	0	0	0	0	0	0^{e}
0.063%	20	50	70	80	90	90^{ab}	0	0	0	0	10	10^{d}
0.125%	40	60	80	100	100	100^{a}	0	0	0	0	10	20^{cd}
0.25%	50	80	100	100	100	100^{a}	0	0	0	10	20	30^{bc}
0.5%	80	100	100	100	100	100^{a}	0	0	10	20	20	30^{bc}
Fumigant test* **												
0%	-	-	-	-	-	0^{c}	-	-	-	-	-	0^{e}
0.063%	-	-	-	-	-	0^{c}	-	-	-	-	-	0^{e}
0.125%	-	-	-	-	-	0^{c}	-	-	-	-	-	0^{e}
0.25%	-	-	-	-	-	10^{c}	-	-	-	-	-	10^{e}
0.5%	-	-	-	-	-	10^{c}	-	-	-	-	-	10^{e}

*Each value represents mean of four replicates
**Means followed by the same superscript within each method of application are not significantly different (P>0.05) according to D M R T
***Mortality rate taken once 2hours after treatment

Table 3: Mean mortality rate of Diazinon on termites (worker & Soldier castes) following topical, residual and fumigant action tests (n = 10/replicate**)**

	Exposure periods (minutes)											
	Worker caste						Soldier caste					
	20	40	60	80	100	120**	20	40	60	80	100	120**
% Conc.	% Mortality*											
Topical application												
0%	0	0	0	0	0	0c	0	0	0	0	0	0^{e}
0.063%	10	30	50	60	70	70^{b}	0	0	0	0	10	10^{de}
0.125%	20	40	60	70	90	100^{a}	0	0	10	10	20	20^{cd}
0.25%	50	60	80	100	100	100^{a}	0	0	10	20	30	40^{ab}
0.5%	50	80	90	100	100	100^{a}	0	20	40	50	50	50^{a}
Residual application												
0%	0	0	0	0	0	0^{c}	0	0	0	0	0	0^{e}
0.063%	20	30	70	80	90	90^{a}	0	0	0	0	10	10^{de}
0.125%	20	70	70	100	100	100^{a}	0	0	0	10	10	10^{de}
0.25%	50	70	80	100	100	100^{a}	0	0	0	10	20	30^{bc}
0.5%	70	90	100	100	100	100^{a}	0	10	10	20	30	30^{bc}
Fumigant test* **												
0%	-	-	-	-	-	0^{c}	-	-	-	-	-	0^{e}
0.063%	-	-	-	-	-	0^{c}	-	-	-	-	-	0^{e}
0.125%	-	-	-	-	-	0^{c}	-	-	-	-	-	0^{e}
0.25%	-	-	-	-	-	0^{c}	-	-	-	-	-	0^{e}
0.5%	-	-	-	-	-	0^{c}	-	-	-	-	-	0^{e}

*Each value represents mean of four replicates
**Means followed by the same superscript within each method of application are not significantly different (P>0.05) according to DMRT
***Mortality rate taken once 2hours after treatment

Table 4: Mean mortality rate of Endosulfan on termites (worker & Soldier castes) following topical, residual and fumigant action tests (n = 10/replicate)

	Exposure periods (minutes)											
	Worker caste						Soldier caste					
	20	40	60	80	100	120**	20	40	60	80	100	120**
% Conc.	% Mortality*											
Topical application												
0%	0	0	0	0	0	0c	0	0	0	0	0	0[e]
0.063%	10	30	50	70	70	80[b]	0	0	0	10	10	20cd
0.125%	20	40	50	80	100	100[a]	0	0	10	10	20	30 bc
0.25%	40	60	90	100	100	100[a]	0	20	30	50	50	50[a]
0.5%	60	80	100	100	100	100[a]	0	30	30	50	50	60[a]
Residual application												
0%	0	0	0	0	0	0[c]	0	0	0	0	0	0[e]
0.063%	20	40	60	90	100	100[a]	0	0	0	10	10	10[de]
0.125%	40	70	90	100	100	100[a]	0	0	10	20	20	20[cd]
0.25%	40	80	100	100	100	100[a]	0	0	20	20	20	20[cd]
0.5%	60	90	100	100	100	100[a]	0	10	20	20	30	30[bc]
Fumigant test* **												
0%	-	-	-	-	-	0[c]	-	-	-	-	-	0[e]
0.063%	-	-	-	-	-	0[c]	-	-	-	-	-	0[e]
0.125%	-	-	-	-	-	0[c]	-	-	-	-	-	0[e]
0.25%	-	-	-	-	-	0[c]	-	-	-	-	-	0[e]
0.5%	-	-	-	-	-	0[c]	-	-	-	-	-	0[e]

*Each value represents mean of four replicates
**Means followed by the same superscript within each method of application are not significantly different (P>0.05) according to DMRT
***Mortality rate taken once 2hours after treatment

Experimental Title: Nutrient dynamics under coffee plantations of different ages in Ibadan, Nigeria (Iloyanomon, C.I., Daniel, M.A. and Iremiren G.O.)

Introduction:
Coffee is a cash crop and a foreign exchange earner. A major factor in the production of coffee is the suitability or otherwise of the soil. Coffee production in Nigeria is spread over variety of agro-climatic zones. This connotes a variety of soils with different nutritional status. The concept of soil – Plant relationship envisages a continuous removal of nutrient from the soil so as to enhance growth and yield. To achieve the desired optimum growth, yield and quality, it is necessary to evaluate the soil nutrient status, though chemical analysis and manorial trials. Bould, (1963) concluded that, soil analysis, alone was not entirely enough for prediction and recommendation, but soil and foliar sample analysis could prove most useful for diagnosing the current nutrient status of fruit crops including coffee. There is therefore need to evaluate the nutrient dynamics under existing coffee plantation.

Objective: To investigate nutrient dynamics under coffee plantations of different ages.

Materials and method
The experiment was carried out in Cocoa Research Institute of Nigeria (CRIN). Four coffee plots were selected Plantation A,B,C,D, with coffee plantation of ages 5 years, 20years and 41years respectively. Two uncultivated lands adjacent to plantation A and B were also selected. The soil of this zone has been classified as Smyth and Montgomery (1962). Each coffee plantation was divided into four block and soil samples collected in both the coffee plantations and adjacent uncultivated land at depths of 0-15cm and 30-45cm, using a soil auger. Plant samples were collected on only the coffee plots. The soil samples collected were air dried, passed through a 2mm sieve and some of the physical and chemical properties of the soil were determined. The leaf samples were put in envelopes, oven dried, milled and analysed for some of their chemical properties.

Results and Discussion
The results of the physiochemical properties of the soil is presented in Table 1. The soil pH in the plots ranged between 6.7-6.9,6.6-6-9 and 6.7-6.9 for soil depth of 0-15cm, 15-30cm and 30-40cm respectively. This soil is slightly acidic.

This soil pH falls within the recommended range for coffee.

The organic carbon in the coffee plantations ranged between 1.81-2.23%, 0.84-0.92%, 0.43-0.98% for soil depths of 0-15cm, 15-30cm and 30-45cm respectively (Table 1). These valves were highest for 5year old coffee plantation and least for the 41years old coffee plantation. The organic carbon in the uncultivated land ranged between 0.55 – 3.28% (table 2) with the adjacent uncultivated land to the 20years old coffee plantation giving higher values than the 20year old coffee plantation. This lower value of the 20year old coffee plantation could be as a result of cropping over the years which has lead to reduction of the organic carbon.

The soil Nitrogen content of the coffee plantations was between 0.9-2.4g/kg for 0-15cm soil depth, 0.7-1.3g/kg for 15-30cm depth and 0.45-0.90g/kg for 30-45cm depth, with N values decreasing with soil depth (Table 1). The values on the top soil were high and adequate for coffee production as it was above the soil critical level of 0.9g/kg. This high N in the soil is reflected in the high N levels in the leaf 1.56-2.00% which is higher than the foliar critical level of 1.10% (Table 3). However the adjacent uncultivated land to the 20year old coffee plot had higher N content than that of the 20 years old coffee plantation (Table 2).

The available P content of the soil of the coffee plantation was between 18.45-24.7mg/kg soil (Table 1) while for the adjacent uncultivated land was 17.10-22.65mg/kg these valves are much higher than the soil critical P valve of 6mg/kg required for coffee. The this is reflected in the high P content of leaf of between 0.08-0.13% P which is above the foliar critical level of 0.07% (Table 3).

The potassium content of the soil of the coffee plantation raged between 0.07-0.30cmg/kg soil. (Table 1). These valves are very low as they are below the coffee soil critical of 0.40%. This low K valve could be contributed to the high demand for K by coffee during the being development and ripening states; hence the coffee berries must have mined K from the soil which was lost through harvesting. The K content of the uncultivated land adjacent to the 20year-old-coffee plantation was high with values of 1.50 and 3.28 coml./kg soil (Table 2). This is above the soil K critical level.

This value was higher than the adjacent 20years old coffee plantation, which had probably lost a sizeable amount of K through harvesting of the coffee berries.

The soil calcium content in the coffee plantation ranged between 3.41-5.96cmol/kg. (Table 1) while that of the uncultivated land ranged between 3.01-12.32cmol/kg soil (Table 2). The calcium content of these soils are much higher than the soil critical value of 0.89cmol/kg. This is not unconnected with the high Ca content of the leaf 2.57-5.99% which is well above the foliar critical level of 0.37%. This high calcium is probably responsible for the soil been slightly acidic. The uncultivated adjacent lands were also observed to have higher pH than the adjacent 20years of coffee plantations (Table 2).

The soil Mg level on the top 0-15cm soils is ranged between 0.84-1.3coml/kg soil, (Table 1) with magnesium level increasing with the age of the coffee plantation. However this increase was not observed between the 35years old and 41year old plantation (Table 2). The Mg values were however well above the critical Mg level. This is reflected in the high foliar Mg content of 0.60-0.81% which was higher than the established 0.13%.

Conclusion

Nitrogen and phosphorous was adequate in all the coffee plantations irrespective of age. Potassium was not sufficient to sustain optimum production. There is therefore need to return potassium mined from the soil through potassium fertilization.

Table 1: Physical and Chemical properties of Soils under Coffee plantations of different ages in Ibadan Nigeria.

	Year after Planting											
	A (5years)			B (20years)								
Parameters	0.15cm	15-30cm	30-45cm	0.15cm	15-30cm	30-35cm	0.15cm	15-30cm	30-45m	0.15cm	15-30cm	30-45cm
PH	6.9	6.9	6.9	6.7	6.6	6.7	6.9	6.8	6.9	6.8	6.7	6.7
Org. C	2.23	0.89	0.43	2.03	0.85	0.55	1.81	0.92	0.98	1.78	0.84	0.78
P(mg/kg)	21.30	18.45	22.50	22.65	22.15	21.50	21.70	21.20	19.65	21.05	24.10	20.00
K(cmol/kg)	0.22	0.11	0.07	0.30	0.26	0.17	0.24	0.20	0.19	0.26	0.19	0.19
Ca(cmol/kg)	5.10	4.25	5.29	4.85	3.54	4.79	5.96	3.57	5.10	4.26	3.88	3.41
Mg(cmol/kg)	0.84	0.95	0.21	1.14	1.02	0.98	1.31	1.04	1.18	1.01	1.00	0.88
Na(cmol/kg)	0.12	0.21	0.06	1.02	0.23	0.17	0.12	0.17	0.04	0.15	0.12	0.15
Exchangeable Acidity	0.08	0.06	0.07	0.07	0.08	0.05	0.06	0.04	0.05	0.07	0.08	0.06
Base saturation	93.74	98.92	99.04	98.04	98.42	99.18	99.22	99.20	99.24	98.78	98.48	98.72
CEC(cmol/kg)	6.36	5.58	7.02	6.59	5.07	6.11	7.74	4.97	6.61	5.75	5.27	4.69
Zn(mg/kg Soil	4.34	1.30	0.90	2.04	1.10	0.84	2.02	0.97	1.16	3.16	1.66	1.36
Cu(mg/kg)	0.74	0.73	0.79	0.93	0.89	0.89	0.98	1.24	1.46	1.27	1.22	1.18
Mn(cm/kg)	46.36	20.32	11.76	38.64	22.88	15.24	45.84	22.20	25.32	37.36	24.32	15.44
Fe(Mg/kg)	6.80	8.40	6.80	8.00	7.60	6.80	6.80	8.00	10.80	8.80	7.20	8.40
Sand(g/kg	764.0	744.0	744.0	624.0	704.0	704.0	664	664	624	624	704	704
Silt(g/kg)	194.0	214.0	194.0	314.0	194.0	154.0	274	194	234	254	234	234
Clay (g/kg)	42.0	42.0	62.0	62.0	102.0	142.0	62	142	142	82	142	202

Table 2: Physical and Chemical properties of Soils under Coffee plantation of different ages and adjustment land in Ibadan Nigeria.

	Year after Planting											
	A (5years)			B (Adjacent forest)			C(20years)			D(Adjacent forest)		
Parameters	0.15cm	15-30cm	30-45cm	0.15cm	15-30cm	30-35cm	0.15cm	15-30cm	30-45m	0.15cm	15-30cm	30-45cm
PH	6.9	6.9	6.9	6.8	6.8	6.8	6.7	6.6	6.7	6.8	7.0	7.1
Org. C	2.23	0.89	0.43	1.80	0.88	0.45	2.03	0.85	0.55	3.28	1.50	0.92
P(mg/kg)	21.30	18.45	22.50	21.30	19.10	17.10	22.65	22.15	21.55	21.90	23.85	21.15
K(cmol/kg)	0.22	0.11	0.07	0.009	0.07	0.06	0.30	0.26	0.17	0.52	0.88	0.77
Ca(cmol/kg)	5.10	4.25	5.29	5.76	3.07	3.01	4.85	3.54	4.79	12.32	6.66	5.13
Mg(cmol/kg)	0.84	0.89	0.21	1.23	0.97	0.96	1.14	1.02	0.98	1.43	1.21	0.89
Na(cmol/kg)	0.12	0.21	0.06	0.12	0.006	0.006	0.23	0.17	0.12	0.41	0.65	0.53
Exchangeable Acidity	0.08	0.06	0.07	0.07	0.09	0.10	0.07	0.08	0.05	0.10	0.08	0.07
Base saturation	98.74	98.92	99.04	99.04	97.89	97.61	98.94	98.42	99.18	99.32	99.16	99.05
CEC(cmol/kg)	6.36	5.58	7.02	7.29	4.26	4.19	6.59	5.07	6.11	14.78	9.48	7.33
Zn(mg/kg Soil	4.34	1.30	0.90	1.70	0.88	0.72	2.04	1.10	0.84	6.12	2.96	1.93
Cu(mg/kg)	0.74	0.73	0.79	0.78	0.75	0.76	0.93	0.89	0.86	1.02	1.05	1.32
Mn(cm/kg)	46.36	20.32	11.76	38.24	20.64	12.44	38.64	22.88	15.24	33.12	69.00	37.36
Fe(Mg/kg)	6.80	8.40	6.80	5.20	8.00	7.60	8.00	7.60	6.80	6.80	6.00	7.60
Sand(g/kg	764.0	744.0	744.0	72.4	72.4	77.4	624.0	704.0	704.0	804.0	724.0	744.0
Silt(g/kg)	194.0	214.0	194.0	23.4	23.4	21.4	314.0	194.0	154.0	154.0	214.0	174.0
Clay (g/kg)	42.0	42.0	62.0	4.2	4.2	4.2	62.0	102.0	74.2	42.0	62.0	82.0

Table 3: Amount of nutrient (%) in coffee leaf under coffee plantation of different ages.
Age of coffee plantation

Parameter	A 5years	B 20years	C 35years	D 41years
N	1.82	1.62	2.00	1.56
P	0.13	0.05	0.11	0.99
K	2.12	2.59	1.59	2.37
Ca	5.99	2.57	4.72	3.61
Mg	0.60	0.25	0.72	0.52
Na	0.57	0.86	0.65	0.52
Cu	0.006	0.009	0.0065	0.0073
Zn	0.0011	0.0022	0.0031	0.0026
Mn	0.0067	0.0022	0.010	0.0026
Fe	0.05	0.040	0.020	0.060

Experimental Title: Assessment of food processing wastes as potential natural insecticides against termites (Asogwa, E.U.; Mokwunye I.U. and Okelana F.A.)

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Introduction

Termites belong to the order isoptera, a taxonomic group of insects whose diagnostic features are the similarity in the shape and size of the membraneous fore and hind wings. They are social insects that live in organized colonies comprising hundreds to millions of individuals inside a nest system, which could be aboreal, epigeal or subterranean (Badejo, 2000). A termite colony consists of several castes, which are morphologically and functionally distinct (Pearce, 1997).

Termites have an important place in economic entomology. They have been implicated in soil modification, which can be brought about by their construction of subterranean galleries, changes in distribution of plant nutrients, changes in nature and distribution of organic matter, changes in soil texture and physical disturbance of the soil profile (Wood et al., 1980; Umeh et al.,(1999). However, the degree of damage done by these pests to the crops and wood is so enormous despite the positive roles played by majority of the species in the soil ecosystem.

Damage to crops, wood and buildings by termites can be reduced to acceptable levels by prophylactic use of synthetic insecticides, but

due to serious limitations and increasing legal restrictions to application and efficacy of these insecticides, there is the need to develop alternative approaches for their control.
This study therefore attempts to evaluate food processing wastes as potential nature insecticides for routine protection against termites in Nigeria.

Materials and Methods:

Preparation of the food processing wastes: In Nigeria, cassava (Manihot esculentum), Maize (Zea mais) and African locust beans (Parkia biglobosa), are among the staple foods. Cassava is processed into "garri and fufu", maize into "pap" (local custard), while locust beans is processed into a local seasoning called "iru or dawadawa". A small scale processing of these food items were carried out in an open laboratory at a temperature of 28 ±3^{o}C and 75 ± 5% relative humidity to generate the wastes for this assessment.

Garri Processing Water (GPW): 2kg of cassava tubers was pealed, washed and grated with a high-speed mill. The grated pulp was filled into a muslin cloth bag and tied securely. Heavy stones or hydraulic pressure was placed or exerted on the sack to press out the cassava water juice. The resulting water is collected into a clean bowl and transferred into a sample collection bottle and labeled.

Fufu Processing Water (FPW): 2kg of cassava tubers was pealed and cut into pieces. They were washed and then submerged in 2 litres of water to ferment for four days. The cassava was removed after fermentation and the water sieved through a double-fold muslin cloth into a clean bowl and transferred into a sample collection bottle and labeled.

Fufu Supernatant Water (FSW): The fermented cassava above was then mashed and sieved through a small basket or plastic sieve in a bowl containing 2 litres of water to remove the lignified central strands. The bowl was allowed to stand for a minimum of 3hours for the cassava paste to settle down. The supernatant water that settle on top was decanted into a clean bowl and transferred into a sample collection bottle and labeled.

Pap Processing Water (PPW): 2kg of maize grains was washed and soaked in 2litres of water to soften and ferment for 2-3days. The maize was removed after 3 days and the water sieved through a double-fold muslin cloth into a clean bowl and transferred into a sample collection bottle and labeled.

Pap Supernatant Water (PSW): The fermented maize above was wet-milled into fine slurry with a high-speed mill and subsequently sieved through a fine cloth sieve or muslin cloth in a bowl containing 2litres of water. The starch, which has been separated from the water, was allowed to stand in the bowl for minimum of 3hours for the sediment to settle down. The supernatant water that settle on top was decanted into a clean bowl and transferred into a sample collection bottle and labeled.

Locust-beans Processing Water (LPW): 2kg of African locust beans seeds was boiled in pots over fire woods for a minimum of 12 hours to soften the tough testa and cotyledons. The water level in the pots is checked hourly and additional water added. The water was allowed to stand overnight before been filtered through a double-fold of muslin cloth into a clean bowl and transferred into a sample collection bottle and labeled.

Collection termites:
Termite samples consisting of workers castes were collected from decaying woods at the coffee experimental plots of the Cocoa Research of Nigeria (CRIN). Ibadan. The fresh and healthy termites were taken to the laboratory for immediate bioassay test with the food processing wastes

Bioassay test:
The bioassay test was carried out with petridishes fitted with filter papers. The petridishes were perforated on the top to provide adequate aeration and prevent the suffocation of the termites. The processing wastes were applied at three treatment levels (25%, 50% and 100%) with a standard termiticide (Chlorophyrifos) treatment for comparism. The filter papers were drenched with 1ml of the various concentrations of the treatments. The treated filter papers in the petridishes were allowed to dry up for 5 minutes before the introduction of ten termites into each petridish. The control test had their petridishes containing untreated filter papers. Each treatment was replicated five times. Mortality counts were taken ad recorded after every 20minutes for 4 hours (which was the maximum time period taken to achieve 100% mortality in over 50% of the petridishes).

Statistical analysis:
All the data obtained were subjected to the analysis of variance and significant means were separated at 5% level using the Tukey's Honestly Significance Difference (HSD).

Results:
The effects of Garri processing water (GPW), Fufu processing water (FPW), Fufu supernatant water (FSW), Pap processing water (PPW), Pap supernatant water (PSW) and Locust beans processing water (LPW) on mean mortalities of termites (worker castes) showed that the various processing waste achieved high mortality rates at the various treatment levels (Tables 1,2,3,4,5 & 6). The mortality rate achieved by most of the various concentrations of the food wastes from the 60^{th} minute differed significantly ($P<0.05$) from their control treatments. However, there was no significant different ($P>0.05$) between the mortality of the standard termiticide (Chloropyrifos) and GPW, PPW and PSW at 100% and 50% treatment levels. The mortality rates of GPW, PPW and PSW at 100% concentration were similar to the standard termiticide as they all gave a 100% kill of termites at the 180^{th} minute (Table 1,4, & 5). Mortality increased with period of exposure of the termites to these potential natural insecticides and at the least treatment level of 25%, GPW, PPW and PSW achieved termite mortality as high as 72% - 76% at the 240^{th} minute of exposure, while FPW, FSW and LPW gave a low mortality of between 30% - 34%. However, the processing wastes when exposed to the termites at concentrations of 50% and 100% was found to be efficacious as natural plant products (botanicals), which has been utilized by various scientists for the control of termites. Their mode of action was very slow and may be regarded as slow poison. A very low mortality rate of between 0% - 42% was achieved by all the wastes assayed within the first 60 minutes when compared with the standard termiticide that achieved a 100% kill of the termites in the 80^{th} minute for all applications (tables 1,2,3,4,5 and 6). However, no mortalities were recorded in the control cages throughout the exposure period.

Discussion
In West Africa, the common fermented cassava products include 'garri', a sour farinaceous meal; 'fufu', a fine paste starchy food; 'lafun'or 'kokonte', a cassava flour product in Nigeria and Ghana respectively. Cassava fermentation varies from one region to another. However, the various cassava fermentation varies from one region to another. However, the various cassava fermentation processes have been broadly categorized into solid-state fermentation and submerged fermentation. Garri is the most important of the fermented cassava products. It is a staple food of about 100million people in West Africa. In Southern Nigeria, it contributes

about 60% of the calorie intake. Garri is fermented, dewatered and toasted semolina of cassava, widely consumed all over West Africa and in Brazil, is the most popular cassava product consumed and the most important item in the diet of millions of Nigerian (IITA, 1990; Kordylas, 1990). It forms a significant part of the diet in many of these countries where it is called "Farinha de Mandioca" (Lancaster et al, 1982). Traditionally it is produced by pressing the juice out of pealed, grated cassava roots, allowing a natural lactic fermentation to take place for 2-5days.

Pap (ogi or akam) is a sour gruel obtained as a result of the submerged fermentation of some cereals (maize, sorghum, millet, guinea corn). The common cereals used in Nigeria are maize in the Sourthern parts, while sorghum and millet are used in the North where it is drier. It is an important indigeneous, traditional weaning food common in the whole West Africa. It is consumed as a breakfast meal by many and serves as food of choice for the sick in many cases.

African locust bean (iru or dawadawa) is by far the most important food condiments in Nigeria and many countries of West and Central Africa. It is normally used as food condiments, however, in poor families it is added generously to sauces and soups and this serves as a low-cost meat substitute.

The processing wastes generated from these food processing processes in Nigeria are readily available within the various communities and posses no environmental nor health hazards, which was the main reason for their selection for this preliminary assessment as potential insecticides.

The termite worker caste was chosen for this test because of their role in the colony. They are known to be the destructive group of termites in any termite colony. They forage and feed voraciously in order to provide food and shelter for the colony and in the process cause enormous damages to plants. Their eradication therefore will disorganize the whole colony and should be adopted as a first step in termite control.

The food processing wastes studied here can be seen as potential source of useful nature control for termites. There is therefore the need to carry out field trials with these processing wastes to confirm the effective mortality rates achieved in this study. However, further studies should be carried out on these wastes in order to isolate, identify, characterize and elucidate the structure of their bioactive compounds.

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FIGURES AND TBLES

Table 1: Relative laboratory toxicity of GPW* to termites in Nigeria

	Exposure periods (minutes)											
	20	40	60	80	100	120	140	160	180	200	220	240
% Conc.	% Termite mortality**											
25	0	4	16	18	34	40	48	56	68	70	72	72c***
50	6	16	26	42	48	68	68	80	82	88	96	96b
100	10	20	30	54	68	80	82	92	100	100	100	100b
Standard	20	40	60	100	100	100	100	100	100	100	100	100b
Control	0	0	0	0	0	0	0	0	0	0	0	0a

*Garri Processing Water
**Each value represents mean of ten replicates
***Means followed by the same letter within a column are not significantly different (P>0.05) by Tukey's test

Table 2: Relative laboratory toxicity of FPW* to termites in Nigeria

	Exposure periods (minutes)											
	20	40	60	80	100	120	140	160	180	200	220	240
% Conc.	% Termite mortality**											
25	0	0	4	8	10	16	20	24	26	30	34	34d***
50	0	0	10	12	22	38	40	46	54	60	68	68c
100	0	0	12	16	24	50	54	58	66	68	76	76c
Standard	20	40	60	100	100	100	100	100	100	100	100	100b
Control	0	0	0	0	0	0	0	0	0	0	0	0a

*Fufu processing water
**Each value represents mean of ten replicates
***Means followed by the same letter within a column are not significantly different (P>0.05) by Tukey's test

Table 3: Relative laboratory toxicity of FSW* to termites in Nigeria

	Exposure periods (minutes)											
	20	40	60	80	100	120	140	160	180	200	220	240
% Conc.	% Termite mortality**											
25	0	0	2	8	12	16	20	24	28	28	30	30d***
50	0	0	10	16	22	38	44	56	58	68	72	72c
100	0	0	14	20	26	54	60	64	68	78	80	80c
Standard	20	40	60	100	100	100	100	100	100	100	100	100b
Control	0	0	0	0	0	0	0	0	0	0	0	0a

*Fufu supernatant water
**Each value represents mean of ten replicates
***Means followed by the same letter within a column are not significantly different (P>0.05) by Tukey's test

Table 4: Relative laboratory toxicity of PPW* to termites in Nigeria

	Exposure periods (minutes)											
	20	40	60	80	100	120	140	160	180	200	220	240
% Conc.	% Termite mortality**											
25	6	10	12	16	22	40	42	60	62	66	74	76c***
50	4	10	22	32	40	64	78	78	88	88	96	98b
100	18	20	34	42	58	78	86	90	100	100	100	100b
Standard	20	40	60	100	100	100	100	100	100	100	100	100b
Control	0	0	0	0	0	0	0	0	0	0	0	0a

*Pap supernatant water
**Each value represents mean of ten replicates
***Means followed by the same letter within a column are not significantly different (P>0.05) by Tukey's test.

Table 5: Relative laboratory toxicity of PSW* to termites in Nigeria

	Exposure periods (minutes)											
	20	40	60	80	100	120	140	160	180	200	220	240
% Conc.	% Termite mortality**											
25	4	8	22	28	48	54	62	67	72	74	74	74c***
50	16	26	30	54	54	60	70	78	78	84	90	96b
100	24	34	42	50	66	76	90	94	100	100	100	100b
Standard	20	40	60	100	100	100	100	100	100	100	100	100b
Control	0	0	0	0	0	0	0	0	0	0	0	0a

**Each value represents mean of ten replicates
***Means followed by the same letter within a column are not significantly different (P>0.05) by Tukey's test

Table 6: Relative laboratory toxicity of LPW* to termites in Nigeria

Exposure periods (minutes)												
	20	40	60	80	100	120	140	160	180	200	220	240
% Conc.	% Termite mortality**											
25	0	0	10	10	10	14	16	20	20	24	32	32***
50	0	0	10	20	22	40	44	44	44	46	50	50[d]
100	0	12	16	26	30	52	56	62	68	76	78	78[c]
Standard	20	40	60	100	100	100	100	100	100	100	100	100[b]
Control	0	0	0	0	0	0	0	0	0	0	0	0[a]

*Locust-beans processing water
**Each value represents mean of ten replicates
***Means followed by the same letter within a column are not significantly different
(P>0.05) by Tukey's test.

Experimental Title: Coffee seedlings grown under arbuscular mycorrphizal and phosphate fertilizers in p deficient soil in Nigeria (Ibiremo, O.S. and Daniel, M.A.)

Introduction

The demand for high yielding coffee seedlings has been on the increase over the years. Production of vigorous seedlings for field rehabilitation and re-planting needs to be enhanced especially in most P – deficient soils. The productivity of coffee is limited both by biotic and abiotic factors. Most of the soils upon which coffee is grown in Nigeria include alfisol, oxisol and ultisol which have been found to be low to moderate fertility levels particularly P.Phosphorous is the most limiting nutrient due to fixation, crop removal and leaching (Malavolta, 1998). The use of inorganic fertilizers for coffee production is limited by a number of factors especially high cost, untimely availability coupled with its environmental implications. This study was set up to evaluate the effect of two sources of P and AM fungi inoculation on the growth and nutrient uptake of coffee seedlings in P – deficient soil.

Objective: To evaluate the effect of two sources of P and AM fungi inoculation on the growth and nutrient uptake of coffee seedlings in P-deficient soil.

Materials and Methods

The study was carried out at Cocoa Research Institute of Nigeria, Ibadan (Latitude $7^0 25'$N and Longitude $3^0 25'$). The soil has been classified as Alfisol (USDA,1990) and Ibadan series (Smyth and Montgomery. 1962) lying on 122m above sea level. The average annual rainfall is between 1275mm, while the average relative humidity is about 76.6%. The factorial experiment had two phosphate fertilizer types and levels viz; single superphosphate (SSP) and Sokoto rock phosphate (SRP) each applied at 30kg $P_2 0_5$/ha and a control. The second factor was inoculation with 20g of arbuscular mycorrhiza (AM) fungi with or without in 5kg polythene pots filled with 5kg top soil.

The experiment was laid out in a complete randomized block design with four replicates, having AM inoculations (with and without), the two fertilizer sources, Sokoto rock phosphate (SRP) and single super phosphate (SSP). Agronomic data were collected on plant height, stem diameter, number of leaves and leaf area fort nightly. At the end of the experiment, destructive sampling was done and plant materials were separated into leaf, stem and roots and soil samples collected from each pot for chemical analysis. Dry matter yield was determined after oven drying the plant materials and nutrient uptake determined by multiplying the nutrient content by the dry matter yield. Percentage mychorrhizal infection from root in young coffee seedlings in the screen house were carefully collected and washed in running water to remove soil on the roots, stored in 50% ethanol in McCartney bottles and percentage root infection was estimated using grid-line intersect according to Giovanetti and Mosse (1980).

Results and Discussions

The results of the soil physico–chemical properties are presented in (Table1). The result showed that, the textural class of the soil used

was sandy clay loam with 692.00g/kg sand, 143.00g/kg silt and 165.00g/kg clay depicting good water holding capacity characteristics. The pH of 5.9 falls within the range required for coffee production. The chemical properties showed the soil was lacking in most plant nutrient especially P hence the addition of P – fertilizers and inoculation of mycorrhiza fungi (Table 2). The result of the agronomic parameters showed the performance of coffee seedlings in the various treatments. (Table 3). The plant height was significantly higher in the pots that received SSP 30.00kg/PO_5 and mychorrhizal inoculations than SRP at the same rate. This could be as a result of fast release of P from SSP that SRP and the more favored symbiotic activities of the mycorrhiza fungi. A similar trend was observation in the number of leaf, leaf area and dry matter yield (Table 3). However, the percentage mycorrhiza found in root and soil tends to agree with that reported by earlier workers. The soil analytical result for various nutrient elements after and nutrient uptake for field recommendation is till been carried out due lack of fund.

Table 1: Physical and chemical characteristics of soil used.

Soil Variables	Values
Physical properties	
Sand g/kg	892.00
Silt „	143.00
Clay „	165.00
Sandy clay loam	
Chemical properties	
PH (H_20)	5.90
Organic Carbon g/kg	9.80
Total N	2.00
Available P mg/kg	20.00
Exchangeable cations	
K cmol/kg	0.50
Ca „	10.00
Mg „	2.00

Table 2: Effect of Phosphate fertilizers and mycorrhiza inoculation on coffee seedlings

Treatment	Plant Height (cm)	Number of leaf	Stem girth (mm)	Leaf area (cm2)	Dry matter yield g/kg	Arbuscular mycorrhiza inoculation %
P1M0	7.05	10.20	0.32	23.77	9.00	63.45
P1M1	12.20	10.60	0.40	12.53	5.50	65.75
P0M1	11.10	7.40	0.20	18.60	4.00	81.10
P2M'0	10.35	9.20	0.20	9.30	4.50	70.30
P2M1	10.45	9.00	0.30	10.30	4.45	76.85
P0M1	11.32	9.10	0.20	9.90	3.00	75.65
P0M0	10.24	6.80	0.40	9.20	2.20	62.05

*P0 = No phosphate fertilizer application; P1 = SSP fertilizer application @30kg/ha
P2 = SRP fertilizer application @ 30kg/ha; M0 = No Mycorrhiza inoculation
M1 = Mycorrhiza inoculation

KOLA PROGRAMME

Experimental Title: Occurrence of ochratoxin A in Nigerian kola nuts (L.N. Dongo[1], Manjula K.[2] & Orisajo S.B.[1)]

Introduction

Ochratoxin (A) is a toxic metabolite produced by a few moulds, mostly in the general Aspergillus and Penicullium that then to colonize crops in the field or after harvest. The growth of the mould and subsequent production of OTA is dependent upon several factors including temperature, humidity and water activity during the harvesting drying and storage of the crops, The content ingestion of food or its product contaminated with ochratoxin A poses a potential threat to both human and animal health, OTA is reported to be carcinogenic (Boorman, 1989), immuntoxic (Haubeck *et al*., 1981), genetoxic (Obrecht *et al*., 1999), immunosuppressive (Mayura *et al.,* 1989), and nephrotoxic (Castegnaro *et al*., 1987).
Many foods and feeds have been reported to be contaminated with OTA, such as cereals (Hohler, 1998), coffee (Pardo *et al* 2004; Romani et al 2002), feeds (Jaimez *et al*, 2004), Wines (Belli *et al*; 2004), Tiger nut (Adebajo, 1993), pulses and beer (Jorgensen, 1998). However, there is no data in the literature regarding OTA contaminates of kola nuts.
The kola tree, *Cola nitida* (vent.) Schott Endl., a member of the tropical family sterculiaceae, is indigenous to West Africa (Bodard, 1960). Its fruits contain seeds known as kola nuts. The nuts are consumed for their stimulant properties and their taste and are traditionally used in Western and Central Africa during weedings funerals and ritual sacrifices. They are also used in the pharmaceutical and food industries to produce cardiac stimulants, laxatives, sedatives and sodas (Egbe and Oladokun, 1987). The kola nut was one of the original ingredients used to make today's most famous soft drink, Coca-Cola. Today's, however, cola manufacturers do not use kola nuts in their secret recipes but rather rely on other ingredients. In Africa, the kolanut is chewed for its alkaloid properties (caffeine, kolanin, and theobromine), which dispel sleep, thirst and hunger. There seems to be a slight preference for white kola nuts over red ones.
The main centre of kola nut production in West Africa is Nigeria, Ghana and the Cote d'Ivore. Annual production from these countries is in excess of 250,000, tons. Nigeria, however, is the primary producing country.
The lack of information on the concentrations of OTA in this high value commodity crop led to this investigation. The objective of this study was to get quantity data on the OTA concentrations of randomly selected retail kolanut samples.

Materials and Methods

Sample

Twenty five samples each of white and red kola nuts were purchased from an open market in Ibadan, Oyo State, Nigeria. In all, fifty (50) samples of the kola nuts were purchased from the open market.

OTA analysis

Five (5) grams each of the samples were used for the extraction of OTA following the indirect competitive Enzyme-linked immunosorbent Assay (ELISA) described by Thirumala-Devi et al (2000), using OTA specific rabbit polyteclona antibodies obtained from ICRISAT, Patancheru, India. Ochratoxin A concentrations in samples was calculated from the standard curve derived from the OTA standards and was expressed in micrograms per kilogram (µg kg^{-1}).

Recovery experiment

The indirect ELISA technique was validated by performing three replicate analysis of uncontaminated white kola nuts spiked at five different levels of OTA (0.02-0.18µg kg-1).

Preparation of ochratoxin A standard stock solution

Ochratoxin A standard (Sigma, St Louis, MO, USA) was prepared by dissolving 1mg OTA in 10ml of Benzene: Acetic acid 99 (v/v) (Olsen *et al*., 2003). One milliliter of 10- µg ml^{-1} Was calibrated spectrophotometrically at 333nm using the value 5550 mol-1 cm-1 for molar absorptivity. After calibration of the OTA solution, an exact volume was evaporated under the fume hood. The residue was redissolved in methanol to get 0.25 µg ml^{-1} which served as stock solution. Further dilutions were made from the stock solution (stored at 4^0C) when needed.

Statistical Analysis

Data analysis was carried

Results and Discussion

Recovery experiment

The recovery of OTA averaged 85% in uncontaminated kola nut spiked with 0.02, 0.06, 0.1, 0.14 and 0.18µg kg-1 OTA as summarized in Table 1. The range of the test was 0.02-0.18µg kg-1 with a detection limit of 0.01µg kg-1.

OTA analysis

Table 2 shows the results obtained from the OTA analysis of 25 each of red and white kola nuts from open markets in Ibadan, Nigeria. Out of the 50kolanut tested for OTA contamination, 49 samples contained detectable amounts of OTA (98%) OTA was detected in all the red kola nuts at levels ranging from 0.8 to 19.1µg kg-1, and the mean value of the samples was 25µg kg-1. The white kola nuts were more contaminated in terms of OTA levels than the red kola nuts with a rang of over 13 to 65.3µg kg-1. However, the mean of the overall samples was 20.6µg kg-1. This is the first report of OTA in kola nuts from Nigeria.

The frequency distribution patterns over different levels of OTA contamination showed that white kola nuts were significantly more contaminated than the red kola nuts (p=0.05). Over 80% of the white kola nuts had OTA levels within the range 10.01-20µg kg-1.

The results showed that red and white kola nuts from the open markets in Ibadan, Nigeria are contaminated with OTA. However, in terms of levels of OTA and mean values red kola nuts are less contaminated than white kola nuts. The reason for this is not known but could be linked to the amounts of caffeine and theobromine contents of the kola nuts. The high levels of OTA in kola in kola nuts especially the white ones pose a public health problem especially in Nigeria, where the chewing of kola nuts is a common practice. Naturally, kola nuts contain high amounts of N-nitroso and tannin compounds which are carcinogenic. With the high OTA contamination, the consumption of kola nits whether in a raw or processed form will contribute to daily intake of OTA. Therefore, efforts towards minimizing the incidence of OTA in kola nuts with respect of handling and storage facilities should ne encouraged. There is need for public enlightment on the health consequences of eating OTA contaminated foods and beverages.

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FIGURES AND TABLES

Table 1: Recovery of Ochratoxin A from spiked uncontaminated white kola nut sample[a]

Added OTA (µg kg)	White kola nut (µg kg)	Detected (%)[b]
0.02	0.0166±0.5	83±0.14
0.06	0.0504±0.8	84±0.15
0.1	0.083±1.6	83 ± 0.8
0.14	0.1232 ± 0.7	88 ±0.47
0.18	0.1566 ±1.38	87 ± 0.7

[a]Each sample was replicated thrice. Values are means = SD
[b] Detected OTA (µg kg) added OTA(µg kg) x100

Table 2: Occurrence of Ochratoxin A in white and red kolanuts from Nigeria

Type of kola nut samples	Number of samples	OTA positive sample	Mean	Range
White kola nut	25	24	30.2	13.9 -65.3
Red kola nut	25	25	11.3	0.8 – 19.1
Total	50	49	20.6	0.8 -65.3

Experimental Title: Occurrence of storage pests of kolanuts across the kola growing belt of Nigeria (*Asogwa E.U.; Ndubuaku T.C.N. and Mokwunye I.U.)

Introduction

Cola and Cola nitida (Schott & End) are the *acuminate* only edible species of kola grown on commercial scale in Nigeria (Jacob, 1973). The cotyledons of the nuts are red, pink or white in colour, which are often observed amongst nuts extracted from the same pod. The colour of the nuts in addition to other parameters such as size, flavor and storage quality determines the quality and price of nuts offered for sale in the market. *Cola acuminata and Cola nitida* are important economic crops in the forest areas of west and Central Africa (Eijnatten, 1969; Oladokun, 1982). The cultivation of kola in Nigeria is ecologically limited to the rain forest zones of the South and riverine areas of the Savannah region. The cultivation of *C. nitida* in Nigeria began sometime in the 19th century. The "goro nut" (*C.nitida*) was observed to be "growing plentifully in the Otta bush" by 1854 while its cultivation was noted in Egba Division in 1902 and in Labochi and environs in 1901. From Agege, *C. Nitida* cultivation presumably spread to the forest areas following, first, the course of the railway line into Abeokuta, Ibadan and Offa, replacing the local c. acuminate and penetrating, later, along streams and river banks into the Guinea Savannah and present South South and Eastern States (Eijnatten, 1969).

The problems posed by storage pest of kola, most especially the kola weevils (*Balanogastris kolae and Sophorthinus spp*) are of immediate importance to the little production often achieved by kola farmers. Generally, it is the most serious post-harvest problem of kolanut, which farmers and kola traders seek to solve. The kola weevils, identified as filed to store pests of kola are capable of causing between 30 – 70% damage on the stored nuts, while 100% damage have been recorded in cases of late harvest and in storage (Daramola, 1973). Unfortunately kola still remains the only indigenous African cash crop that has both attracted international sympathy. It is sometimes referred t as an "orphan crop" as most countries outside
Africa and even Africans to an extent shy away from its production and improvement.

This study was therefore designed to reassess the distribution and frequency of occurrence of these very important pests of kola (*Balanogastris kolae and Sophorhinus spp*) within the kola producing belts of Nigeria with a view of formulating standard integrated packages for their control.

Materials and Methods

Collection of kola pods: Random samples of matured or fallen kola pods (Cola nitida) were procured from kola farmers across the kola belt, which cuts across the States in South West, South East, South South and North central geopolitical zones of Nigeria (Fig.1, Table 1). A total of ten (10) pods were procured from two locations within each state.

Collection of kola nuts: Random samples of sixty (60) cured kolanuts (*Cola nitida*) without blemish were procured from kolanut retail vendors from two locations in each State across the kola belt of Nigeria (Fig1, Table 1).

Pre-processing assessment of the pods: The pods were carefully cut to extract the fresh kolanuts. Each of the ten pods served as a replicate and were subsequently subjected to the following assessments:

- Total number of nuts in each pods
- Total number of nuts with their cotyledons infested with weevils
- Total number of larvae per pod
- Total number of adult weevils per pod
- Total number of weevil exit holes on the nuts per pod.

Primary processing of the extracted nuts: The seed coat or testa of the nuts from each pod was removed by soaking the nuts in water for 24 hours to enhance rottening, after which the nuts were skinned and rinsed in fresh water. The

soaking and washing was done differently for each pod. The rinsed nuts were collected differently in flat baskets through which excess water drained off before they were cured in the laboratory (temperature 28± 3^0C and relative humidity 75 ±5% respectively) for a period of 72 hours, during which considerable "sweating" that reduces the moisture content of the nuts takes place.

Storage of the processed fresh nuts: Random sample of six(6) nuts were selected from each processed kola pod and stored differently in black light gauge polythene bags of dimension 42.5 x 21.0cm for 3 months, under laboratory conditions of temperature and relative humidity 28±3^0C and 75±5% respectively. A space of 20cm was maintained between replicates.

Storage of the procured cured nuts: The procured cured nuts from each state were stored in ten replicates of six (6) nuts per polythene bag for the same duration, under laboratory conditions of temperature and relative humidity 28±3^0C and 75±5% respectively. A space of 20cm was maintained between replicates.

Post storage assessment of the nuts: After 3months of storage, the kolanuts in each poly-bag were observed carefully to access the following parameters:

- Total number of nuts with sign of weevil infestation
- Total number of larvae per treatment
- Total number of adult weevils per treatment
- Total number of weevil exit holes per treatment

Data analysis: The resulting data were subjected to the analysis of variance and significant means were separated at 5% level using the Tukey's Honestly Significance Difference (HSD).

Results:

Table 2 shows the result of a pre-processing assessment of kola pods collected from different locations across the kola belts of Nigeria. Ogun and Ondo States had the highest mean number of nuts (9.4) in the pods collected while others like Abia, Ebonyi, Enugu and Akwa-Ibom States had the lowest mean number of nuts per pod (7.7,7.8,7.9 & 7.9 respectively). Generally, weevils at varying degrees infested all the nuts in the pods collected from the various States. It was observed that Ondo, Cross-River, Osun and Oyo States had a fresh nut weevil infestation of 99%, 97.6%, 97.6% and 96.4% respectively, while States like Enugu, Ebonyi, Benue and Kogi had a relative high infestation level of 70.9%, 75.7%, 79.7 and 77.9% respectively. Apart from Cross-River, Ondo and Ogun States with the highest mean number of larvae infestation found on the pods (28.4, 27.9 and 25.7), most locations in the South West zones recorded relatively high mean number of larvae as well.

The mean number of adult *B.Kolae* collected from pods across all the zones were relatively low and ranged between 2.2 for Cross-River to 0.2 for Enugu. Adult *Sophrorhinus* spp were found in very few locations unlike adult *B. Kolae* that was widely distributed across the States. Meanwhile, there was no exit hole found on the nuts collected from the pods across all the States, indicating no direct emergence of adult weevils from the pods across all the States, indicating no direct emergence of adults weevils from the nuts at that point

(Table 2). The weevils are "field to store pest" of kolanuts and at that point of assessment most of the weevils were yet to complete their life cycles, which was the reason for the low number of adults and no exit holes recorded.

(Table 3) shows the post storage assessment of nuts selected from the kola pods collected from different locations across the kola belts of Nigeria. From the result, it was observed that after 3 months of storage, kola weevils resulting

to an infestation level of 100%, infested all the nuts selected from the kola pods. There was however a 0% larvae emergence from the nuts. The mean numbers of adult *B.kolae* found varied between 19.5 at Cross-River to 10.6 at Enugu State, while that of Sophrorhinus spp were very few with Cross-River and Oyo States recording the highest mean number of 1.4 and 1.3 respectively. The mean number of exit holes on nuts recorded for the various treatments ranged from 20.9 (Cross-River) to 11.3 (Ebonyi State). Apparently, adult weevils had laid eggs on the nuts selected from the kola pods in the field and within the 3 months storage period, 2-2 generations of the weevils were produced. This therefore accounted for the relatively high number of adult *B.kolae* and exit holes recorded after the storage period. The higher mean number of *B.kolae* observed when compared to a relatively few *Sophrorthinus* spp indicates and abundance of *B.kolae* in Nigeria. This may probably be due to environmental factors or differences in the biology of the various weevil species, however further studies need to be carried out to confirm this.

Table 4 shows a varying degree of weevil infestation on procured cured kolanuts after 3 months storage. There was relatively low infestation level of the weevil, which ranged from 21.7% (Cross-River State) to 3.3% for Ebonyi and Enugu States. There were no larvae found on the nuts. While adult emergence was between 0.7 (Cross-River) to 0.0 (Ebonyi and Enugu States). No adult *Sophrorhinus* spp was recorded for all the locations sampled across the kola belts. The very low infestation level and corresponding low weevil emergence from the procured cured nuts goes further to confirm the fact that kola farmers and vendors still subject the nuts to chemical treatment for the control of kola weevils .

Discussion:

The kola weevils *(Family Curculionidae)* have been identified as the most destructive insect pest of kolanut in West Africa (Daramola, 1973; 1978). The adult *B.kolae* is dark brown 3-4mm long and 1.5 – 2mm wide (Ivbijaro, 1976). While adult S.spp measures 4 -5.5mm long (Daramola 197). Their mouthparts are adapted for piercing and puncturing the kolanuts to obtain food and for making ovipositional holes, thus resulting in considerable economic damage to the kolanuts (Gerald, 1967). From the results of this study, it is evident that kola weevils especially *B.kolae* are widely distributed across the kola growing belt of Nigeria at varying degrees and such infestation normally starts on the field. They are classified as "field-t-store pest" as their infestation is initiated in the field and persists in storage (Daramola & Ivbijaro, 1975).

The results also corroborate previous observation made by Albert & Mallamaire in 1955 that the geographical distribution of some of the weevils is widespread and all the kola trees in Africa are believed to be infested. A significant infestation of 0-70% and in some cases of late harvest 100% has been reported I Cote D'Ivoire, Guinea and Nigeria (Goormans and Pujol, 1955; Daramola, 1973; Daramola & Ivbijaro, 1975). According to Daramola % Taylor 1975, the havoc caused by this insect pest approximately claims 60% of the total kolanut production in Nigeria.

The farmers and kola vendors are in the habit of adding Garmalin 20 EC (Organ chlorine insecticide that has been banned) and other synthetic insecticides to the water for soaking fresh Cola acuminita or Cola nitida during primary processing. They usually add between 10 to 20mls to a bowl of water 20-30L) for soaking a basket of fresh nuts depending on the size of the basket. The chemicals are usually available in the kola markets, where it is hawked freely in small quantities at affordable prices. The farmers have resorted to this practice to drastically reduce the menace of weevil infestation on stored kolanuts, as untreated nuts deteriorates within 3 to 4 weeks. Unfortunately this act is not durable, as kolanut does not undergo any other formal processing before

consumption. There is an urgent need for an alternative means of protecting kolanuts from the weevils to be proffered and transferred to kola farmers and merchants so as to save kola consumers of an impending calamity. The next phase of our study therefore will focus on the aspects of alternative weevil control measures.

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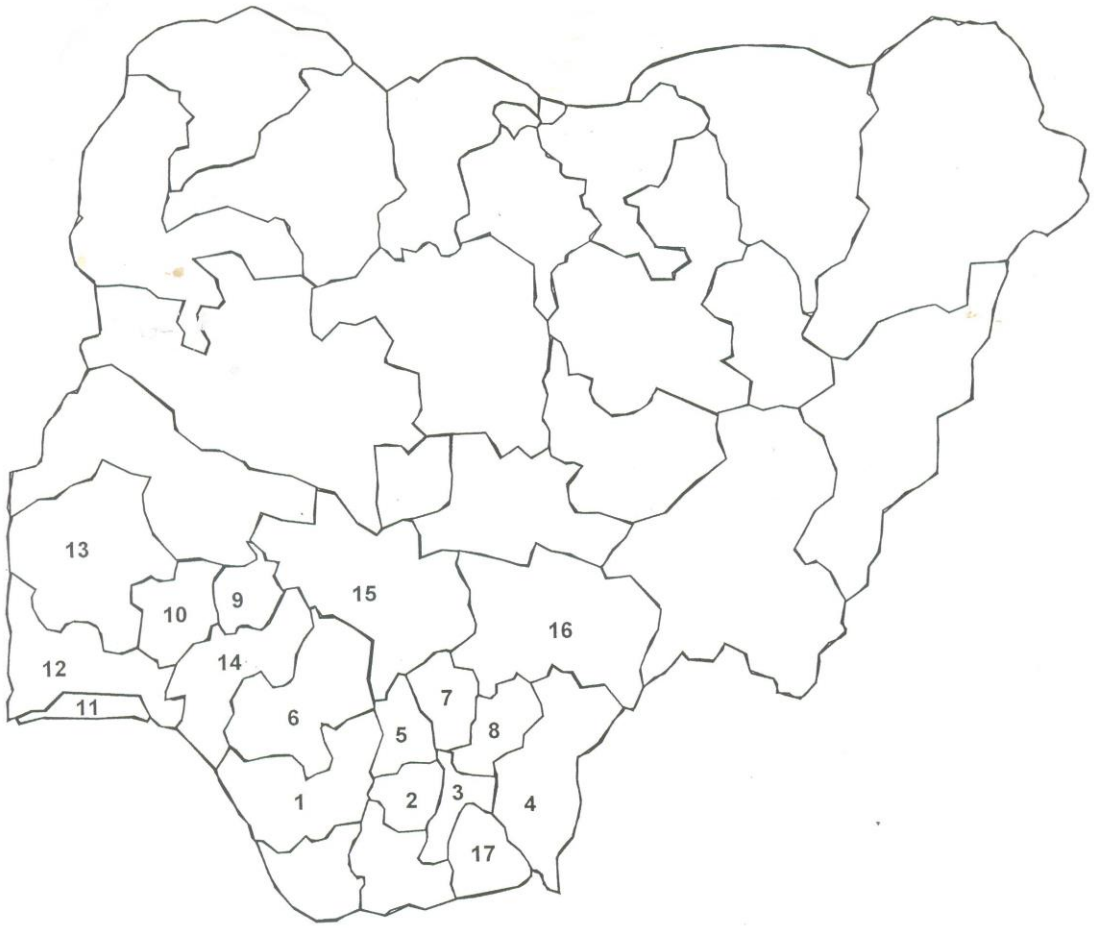
Figure 1. Map showing the distribution of kola production in Nigeria



LEGEND

1. DELTA
2. IMO
3. ABIA
4. CROSS RIVER
5. ANAMBRA
6. EDO
7. ENUGU
8. EBONYI
9. EKITI
10. OSUN
11. LAGOS
12. OGUN
13. OYO
14. ONDO
15. KOGI
16. BENUE
17. AKWA IBOM

Table 1: Variation locations from where the kolanut pods and nuts were procured from

State	Location (Towns)*
Abia	Ariam and Ndioro
Akwa-Ibom	Ikot-ekpene and Ikot-inang
Anambra	Onitsha and Awka
Benue	Otukpo and Gboko
Cross-River	Ajassor and Ogoja
Delta	Umunede and Agbor
Ebonyi	Nkalagu and Abakaliki
Edo	Uhonmora and Ohosu
Ekiti	Ikare and Ado
Enugu	Ohollo-Afor and Ogbede
Imo	Emekuku and Amusari
Kogi	Okene and Ejule
Lagos	Epe and Ikorodu
Ogun	Ogunmakin and Mamu
Ondo	Ile-Oluji and Ala
Osun	Iwo and Osogbo
Oyo	Idi-Ayunre and Moniya

*Random samples of kola pods and nuts were procured from 5 different kola farmers or vendors in each location

Table 2: Varying degree of weevil infestation on kola pods from different locations across the kola belt of Nigeria during pre-processing assessment of the pods

	% Infestation & mean number infestation by various weevil stages*						
Locations	Total Nuts	Infested nuts	% infestation	Larvae**	B.Kola**	S.app**	Exit** holes
Abia	7.7	7.1	92.2	13.9^{ef}	0.7^{bc}	0.1^{ab}	0.0^{a}
Akwa-Ibom	7.9	7.2	91.2	15.6^{def}	0.9^{abc}	0.3^{ab}	0.0^{a}
Anambra	8.3	6.9	83.1	14.0^{ef}	0.3c	0.0^{b}	0.0^{a}
Benue	8.6	6.6	76.7	13.5^{ef}	0.7^{bc}	0.0^{b}	0.0^{a}
Cross-River	8.4	8.2	97.6	28.4^{a}	2.2a	0.7^{ab}	0.0^{a}
Delta	8.5	7.9	92.9	20.7^{bcd}	0.7^{bc}	0.3^{ab}	0.0^{a}
Ebonyi	7.8	5.9	75.7	11.2^{ef}	0.3^{c}	0.0^{b}	0.3^{a}
Edo	8.7	7.3	84.0	16.0^{cde}	0.6^{bc}	0.3^{ab}	0.0^{a}
Ekiti	8.8	7.3	82.9	15.7^{de}	0.4^{bc}	0.0^{b}	0.0^{a}
Enugu	7.9	5.6	70.9	10.2^{f}	0.2^{c}	0.0^{b}	0.0^{a}
Imo	8.3	6.8	82.0	11.5^{ef}	0.3^{c}	0.0^{b}	0.0^{a}
Kogi	8.1	6.3	77.9	13.2^{ef}	0.3^{c}	0.0^{b}	0.0^{a}
Lagos	9.1	8.9	97.9	23.2^{ab}	1.2^{abc}	0.4^{ab}	0.0^{a}
Ogun	9.4	8.9	94.8	25.7^{ab}	1.5^{abc}	0.7^{ab}	0.0^{a}
Ondo	9.4	9.3	99.0	27.9^{a}	1.7^{ab}	0.7^{ab}	0.0^{a}
Osun	8.6	8.4	97.6	23.1^{ab}	1.3^{abc}	0.6^{ab}	0.0^{a}
Oyo	8.2	7.9	96.4	21.2^{bc}	1.4^{abc}	0.8^{a}	0.0^{a}

*Each value represents mean of ten replicates
**Means followed by the same superscript are not significantly different (P>0.05) using Tukey's test

Table 3: Varying degree of weevil infestation on kola pods from different locations across the kola belt of Nigeria during pre-processing assessment of the pods

	% Infestation & mean number infestation by various weevil stages*						
Locations	Total Nuts	Infested nuts	% infestation	Larvae**	B.Kola**	S.app**	Exit** holes
Abia	6.0	6.0	100	0.0^{a}	15.5ab	1.0^{abc}	16.3
Akwa-Ibom	6.0	6.0	100	0.0^{a}	12.1^{bcd}	0.6^{abcd}	12.8^{bcde}
Anambra	6.0	6.0	100	0.0^{a}	14.6bc	0.0^{d}	4.8^{bcde}
Benue	6.0	6.0	100	0.0^{a}	13.8^{bcd}	0.0^{d}	15.1^{bcde}
Cross-River	6.0	6.0	100	0.0^{a}	19.5^{a}	1.4ab	20.9a
Delta	6.0	6.0	100	0.0^{a}	15.9^{a}	0.6^{abcd}	16.7^{abc}
Ebonyi	6.0	6.0	100	0.0^{a}	10.2dc	0.0^{d}	11.3e
Edo	6.0	6.0	100	0.0^{a}	14.9^{abc}	0.6^{abcd}	14.9^{bcde}
Ekiti	6.0	6.0	100	0.0^{a}	14.1^{bcd}	0.0^{d}	15.0^{bcde}
Enugu	6.0	6.0	100	0.0^{a}	10.6dc	0.0^{d}	11.9^{de}
Imo	6.0	6.0	100	0.0^{a}	13.5^{abc}	0.3^{cd}	14.7^{bcde}
Kogi	6.0	6.0	100	0.0^{a}	12.2^{bcd}	0.0^{d}	12.5^{cde}
Lagos	6.0	6.0	100	0.0^{a}	16.7^{ab}	1.1^{abc}	17.3^{ab}
Ogun	6.0	6.0	100	0.0^{a}	16.5^{ab}	1.5^{a}	17.5^{ab}
Ondo	6.0	6.0	100	0.0^{a}	16.1^{ab}	1.1^{abc}	16.9^{abc}
Osun	6.0	6.0	100	0.0^{a}	13.5^{bcd}	1.0^{abc}	13.7^{bcde}
Oyo	6.0	6.0	100	0.0^{a}	15.5^{ab}	1.3ab	16.0^{bcde}

*Each value represents mean of ten replicates
**Means followed by the same superscript are not significantly different (P>0.05) using Tukey's test

Table 4: Varying degree of weevil infestation on kola pods from different locations across the kola belt of Nigeria during pre-processing assessment of the pods

	% Infestation & mean number infestation by various weevil stages*						
Locations	Total Nuts	Infested nuts	% infestation	Larvae**	B.Kola**	S.app**	Exit** holes
Abia	6.0	6.0	15.0	0.0^{a}	0.4a	0.0^{a}	0.8^{ab}
Akwa-Ibom	6.0	6.0	20.0	0.0^{a}	0.5^{a}	0.0^{a}	1.1^{ab}
Anambra	6.0	6.0	5.0	0.0^{a}	0.1^{a}	0.0^{a}	0.4^{b}
Benue	6.0	6.0	8.3	0.0^{a}	0.2^{a}	0.0^{a}	0.7^{ab}
Cross-River	6.0	6.0	21.7	0.0^{a}	0.7^{a}	1.0a	1.7^{a}
Delta	6.0	6.0	16.7	0.0^{a}	0.4^{a}	0.0^{a}	1.1^{ab}
Ebonyi	6.0	6.0	3.3	0.0^{a}	0.0^{a}	0.0^{a}	0.2^{b}
Edo	6.0	6.0	16.7	0.0^{a}	0.4^{a}	0.0^{a}	1.0^{ab}
Ekiti	6.0	6.0	6.7	0.0^{a}	0.4^{a}	0.0^{a}	0.7^{ab}
Enugu	6.0	6.0	3.3	0.0^{a}	0.0^{a}	0.0^{a}	0.2^{b}
Imo	6.0	6.0	8.4	0.0^{a}	0.2^{a}	0.0^{a}	0.8^{ab}
Kogi	6.0	6.0	10.0	0.0^{a}	0.2^{a}	0.0^{a}	0.8^{ab}
Lagos	6.0	6.0	11.7	0.0^{a}	0.4^{a}	0.0^{a}	0 .9^{ab}
Ogun	6.0	6.0	15.0	0.0^{a}	0.5^{a}	0.0^{a}	1.4^{ab}
Ondo	6.0	6.0	8.4	0.0^{a}	0.1^{a}	0.0^{a}	0.6^{ab}
Osun	6.0	6.0	11.7	0.0^{a}	0.3^{a}	0.0^{a}	0.8^{ab}
Oyo	6.0	6.0	11.7	0.0^{a}	0.4^{a}	0.0^{a}	0.8^{ab}

*Each value represents mean of ten replicates
**Means followed by the same superscript are not significantly different (P>0.05) using Tukey's test

STATISTICS AND SOCIO-ECONS PROGRAMME

Experimental Title: An appraisal of the impact of agro-services corporation on food crop production: a case of cocoa farming households of Ogun State, Nigeria.
(Oluyole K. A. and Lawal J.O.)

Introduction:
Agricultural production in Nigeria is mostly undertaken by the traditional peasants who are responsible for about 90 percent of the total food production with low output per hectare (Okuneye, 2002; Ogunwale, 2005). The inputs of these traditional peasant farmers are land and family labor with little or no capital investment and they seldom use fertilizer, herbicides, plant protection chemicals, improved seeds and mechanization (Lawal and Shittu, 2006; Okuneye, 2002). This rudimentary method of farming however accounted for farmers' low level of productivity. This, coupled with ever-increasing population has created a food supply-demand gap. The problem of food supply-demand gap is more pronounced among cocoa farmers. This is because cocoa farmers believe that they derive more income from cocoa production than food crop production; hence, they devote most of their resources toward cocoa production at the detriment of food crop production (Alabi *et al*., 1992). The resultant effect of these is the shortages of food crop production among cocoa farmers (Adegeye, 1995).

Agro-services Corporation which was established in 1980 was to meet the farmers' requirements for farming operations in terms of farm inputs, machinery and other useful inputs for agricultural development. The corporation since its inception has contributed immensely to the production of food crops, cash crops and livestock. It is quite interesting that having established the corporation for more than 25 years ago, it is ripped enough to appraise the impact of the corporation on food crop production (especially by cocoa farming households) in the study area.

Methodology:
The study was undertaken in Ogun state, Nigeria. Information was obtained from the respondents with the aid of well-structured questionnaires and the questionnaires were administered to two sets of respondents. Fifty questionnaires were administered to the beneficiaries of inputs [farm mechanization, herbicides, fertilizer and seeds] from Agro-services corporation while fifty questionnaires were also administered to the non-beneficiaries of inputs from Agro-services corporation. Purposive random sampling technique was used to select the respondents. This is because the focus was generally on cocoa farmers who were producing maize/cassava alongside with cocoa production on their farms. Maize/cassava was chosen because they form the staple food for cocoa farming households in the area.

The data collected was analyzed using Descriptive statistics, Difference of means, Chi-square and Gross margin Analysis.

Results and Discussion:
The result of the Chi square analysis showed that socio-economic characteristics of the farmers are related to farmers' groups while the difference of means showed that there is a significant difference in the level of output per hectare of beneficiaries and that of non-beneficiaries. Gross margin analysis shows that the gross margin per hectare for beneficiaries (₦20, 370) is more than that of non-beneficiaries (₦14, 290). The increase might be due to the fact that output was higher as a result of the access to agro-services inputs such as mechanization, herbicides, improved seeds and others by the beneficiaries.

Conclusion and Recommendations:

The study concluded that farmers that are beneficiaries are more productive than those of non-beneficiaries. The study therefore gives the following recommendations.

(i) Adequate timely supply of improved seeds, fertilizers and other inputs to the farmers at affordable prices.

(ii) Considerable reduction in the tractor hiring costs should be considered for small scale farmers

(iii) Capital must be provided by the government to the agro-services corporation for the purchases of more farm machines and for the repairs of damaged ones.

(iv) Farmers should be encouraged to form themselves into cooperative societies for easy access to the use of tractor services at lower cost. Such farmers will have a sense of belonging and with that; they can improve their output, income and standard of living.

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FIGURES AND TABLES

Table 1: Summary of the Chi-square tests of the relationship between farmers' group and farmers' socio-economic characteristics

Variable	Degree of freedom	X^2_c	X^2_t	Decision
Age	5	14.22	11.07	Ho rejected
Farming Experience	5	13.32	11.07	Ho rejected
Level of Education	5	12.50	11.07	Ho rejected
Household size	5	11.90	11.07	Ho rejected
Farm size	5	15.42	11.07	Ho rejected

Source: SPSS Computer Analysis Print out

Table 2: Gross margin per hectare for both the beneficiaries and non-beneficiaries

Item	Beneficiaries (₦)	Non-beneficiaries (₦)
Gross revenue	39,400	31,330
Cost of hired labor	3450	6200
Cost of ploughing	1800	-
Cost of herbicides	5750	-
Cost of fertilizer	2580	1360
Cost of seed	400	550
Cost of ridging	1050	2500
Cost of cassava stem	150	230
Cost of planting	1000	1200
Cost of harvesting	2500	2200
Cost land clearing	-	2800
Total variable costs	18680	17040
Gross margin	20370	14290

Source: Field survey, 2006

Experimental Title: The effects of social capital on production. A case study of cocoa production in Ondo State, Nigeria. (Oluyole, K.A. and Lawal, J.O.)

Introduction:

Social capital is anything that facilitates individual or collateral action, generated by networks of relationships, reciprocity, trust and social norms (Nan, 1999). Hence, it is the social structure that facilitates coordination and cooperation among individuals (Putnam *et al*, 1993; Putnam, 1995). Social capital is an investment in social relations with expected returns. Unlike traditional forms of capital, social capital is not depleted by use, but in fact depleted by non-use. It is a fact that individuals are able to establish and maintain relational associations. Farmers (especially cocoa farmers) tend to form association among themselves and the commonest associations among cocoa farmers are cooperative societies, Cocoa Association of Nigeria (CAN), Cocoa farmers Association of Nigeria (CFAN) and Cocoa Growers Association of Nigeria (COGAN). Forming associations among farmers is seen by the farmers as a very important task, this is because of their belief that some fringe benefits are accrued to them by doing so. But the question is, do these farmers actually derive benefits from these associations? It is the scope of this study to investigate this, that is, to investigate the effect of social capital on cocoa production in the study area.

Methodology:

The study was carried out in Ondo state of Nigeria. Two Local Government Areas (Idanre and Ondo East) were chosen for the study. Forty six respondents were randomly selected; this includes twenty three respondents that were members of association while twenty three respondents were non-members of association. Information was collected from the respondents with the aid of structured questionnaires. The data from the information collected was analysed with descriptive statistics, budgetary analysis as well as student t- test.

Results and Discussion

Table 1 showed that the average gross margin per farmer per year as well as the average net income per farmer per year for the farmers with association were ₦122, 047 and ₦114, 296 respectively. The Table also showed that the gross margin per farmer per hectare was ₦1112. It could also be observed in the Table that the gross margin per farmer, as well as, the average net income per farmer for farmers without association were ₦78, 815 and ₦ 71, 433 respectively. Also the gross margin per farmer per hectare was ₦ 1, 018. Comparing the two groups together, it could be discovered that the gross margin per farmer, net income per farmer as well as gross margin per farmer per hectare are higher among farmers with association than those of farmers without association. The increase in all these indicators (gross margin per farmer, net income per farmer as well as gross margin per farmer per hectare) among the farmers with association might be due to the fact that by virtue of joining association they derived some benefits. These benefits might be access to credit, access to training, access to subsidized agro-chemicals and other agricultural inputs. These, when ploughed into their farming business, it would increase their efficiency thus enabling them to have more proceeds from their farms than those farmers without association. However, the result of the t-test showed calculated t of 4.067. This is greater than the tabulated t-value of 2.82 (at 22 degrees of freedom). Therefore, there was significant difference in the means of the gross margin of the farmers with association and the means of the gross margin of the farmers without association. The significance might be due to the fact that the farmers with association derived special benefits from the association thus making their gross margin to substantially be different from those farmers without association.

Conclusion

The result of the cost and returns analysis showed that gross margin per farmer, net income per farmer. as well as gross margin per farmer per hectare ,were higher among farmers with association than those of farmers without association. The result of t-test showed that there was significant difference in the means of the gross margin of the farmers with association and the means of the gross margin of the farmers without association.

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FIGURES AND TABLES

Table 1: Cost and Returns Analysis for Farmers with Association and farmers without Association

S/N	Item	Farmers with Association	Farmers without Association
1	Total Variable Cost	1,995,410	1,449,913
2	Average Variable Cost	86,757	63,040
3	Total Fixed Cost	178,270	169,780
4	Average Fixed Cost/farmer	7,751	7,382
5	Total Cost	2,173,680	1,619,693
6	Average Total Cost/farmer	94,508	70,421
7	Gross Revenue	4,802,500	3,262,653
8	Gross Revenue/farmer	208,804	141,854
9	Gross Margin	2,807,090	1,812,740
10	Gross Margin/farmer	122,047	78,815
11	Net Income	2,628,820	1,642,960
12	Net Income/farmer	114,296	71,433
13	Gross Margin/farmer/hectare	1122.	1,018

Source: Field Survey, 2007

Experimental Title: Potentials of wealth creation through the conversion of cocoa pod husk into cocoa pod husk organic manure in Nigeria. (Obatolu, B. O; Adejumo, M. O. Shittu, T. R. and Daniel, M. A.)

Introduction

Cocoa Production in Nigeria has been a very important economic crop for over 70years, it is by far the most important economic tree crop. It grosses the count fry an estimated $ 0.46 billion US dollar annually. Cocoa is produced in commercial quantity in 14 recognized cocoa producing states. The principal export from the cocoa industry in Nigeria is the cocoa bean (Obatolu and Okuneye, 2003). In the process of producing the bean, the cocoa pod-husk is produced, as left over by-product after the cocoa bean would have been harvested from the pod.

The cocoa pod-husk is regarded as a waste product by farmers who often form the habit of storing the pod-husk as large dunes/heap on their farms inside existing cocoa plantations/plots (Nworgu, Hamzat, Oduola and Arasi, 2003). This habit is dangerous to the farm and farmers as research efforts has shown that dangerous pathogens affecting the health status of the cocoa plantations. The pathogen stored in heaps does not make the spraying of farms effective as the pathogens can return to the plantations from the heaps.

However, further research at cocoa Research Institute of Nigeria has shown that cocoa pod-husk can be used as an organic fertiliser and in the recent time when fortified with a ratio of inorganic fertiliser such as NPK or urea, it reduces the bulkiness associated with organic fertiliser, and more importantly is able to augment the nutrient deficiency of pure organic cocoa pod-husk fertiliser. Some of the identified benefits of organic fertiliser is that they can be produced locally on the farm, food items produced are free from harmful chemicals, low capital investment is needed to start production. In addition, other benefits is that it ensures safe environment and can provide employment at the grass roots (Saling, 2007).

Other uses of cocoa pod-husk, includes the use of cocoa pod-husk ash in the manufacture of a local black soap which is widely acceptable to farmers. A recent study in CRIN has shown that certain heavy metals can be absorbed by cocoa pod-husk making it relevant as a purifier (Yahaya and Ajao, 2003). Equally, cocoa pod husk has been used successfully in the poultry industry in feeding rations (Olubamiwa and Hamzat, 2005).

The issue of farm income diversification is a very important subject to a farmer. This topic becomes inevitable considering the effect of global markets on the demand of cocoa beans given that less than 20% of the beans are consumed in the country (Oduwole, 2004). In addition, there is the need to prevent stable income in the event of the possibility of total crop failure, as the pods can still be of some degree of use. Hence if farmers are able to transform heaps of cocoa pod-husk into organic fertiliser, often requiring little technology, farmers will be turning waste to wealth and there by improving the sustainability of the cocoa income and industry.

The objective of this study is to estimate the volume of income that will accrue to the nation as a result of transforming cocoa pod-husk waste in farms into wealth.

Methodology

Primary data was collected with the aid of structured questionnaires on the variables that affect the production of cocoa pod husk by farmers and average cost estimates of the indices computed from 6,000 households in the 14 cocoa producing states was used in determining the total cost of production.

A model explaining the relationship between the factors of production and the income derived from the operation was developed as;

$I_1 = 0.2f\{Q[H+B+M+NPK+T]\}$ ……1

$I_2 = 0.15f\{Q[H+B+M+NPK+T]\}$ ……2

Equation 1 and 2 is defined as follows;

I_1 = Profit (Income) derived from selling cocoa pod husk organic manure at 20% total cost of production

I_2 = Profit (Income) derived from selling cocoa pod husk organic manure at 15% total cost of production

Q = National output (total) of dry weight cocoa pod-husk.

H = Total cost of man-hour labour for harvesting cocoa pod

B = Total cost of bagging

M = Total cost of milling

NPK = Total cost of inorganic fertiliser NPK addition

T = Total cost of Tax for the marketing of fertiliser

The data was subjected to income modeling; income estimated on state basis was summed up to provide the estimated national income from cocoa pod husk production at 15% and 20% of the cost of production.

Results and Discussion

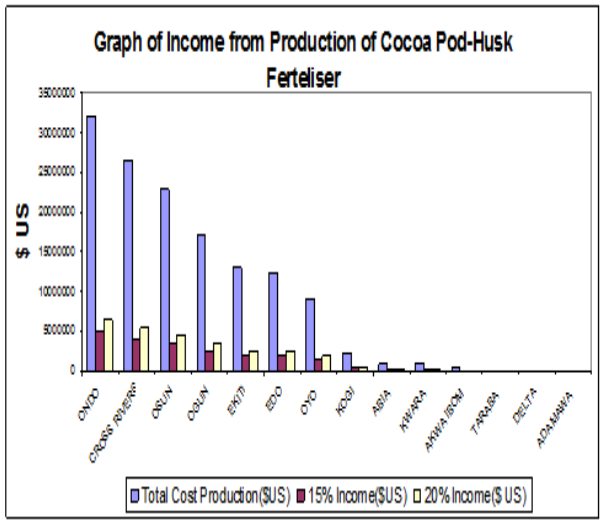
Results of the analysis are displayed in table 1 and figure 1.

Table1: Distribution of Production, cost of production and income of processing waste Cocoa Pod –husk into organic fertilizer

STATE	Dry Cocoa Pod-Husk(tonnes)	Total Production Cost of Fertiliser ($US)	15% Income($US)	20% Income($ US)
ONDO	105410	32165700	4824860	6433150
CROSS RIVERS	87143	26591600	3988740	5318320
OSUN	74723	22801800	3420280	4560370
OGUN	56514	17245100	2586760	3449020
EKITI	42667	13019800	1952970	2603950
EDO	40322	12304200	1845630	2460840
OYO	29187	8906410	1335960	1781280
KOGI	7183	2191840	328777	438369
ABIA	2979	908970	136346	181794
KWARA	2520	768863	115329	153773
AKWA IBOM	1332	406567	60985	81313
TARABA	141	42977	6447	8595
DELTA	106	32233	4835	6447
ADAMAWA	4	1290	194	258
TOTAL	**450229**	**137387350**	**20608112**	**27477480**

Based on the analysis results table 1, it showed that income varied among the cocoa producing states. While states like Ondo, Osun and cross-Rivers were have the potential of earning over 3 million US dollars, other states like delta and Adamawa are capable of producing less than $5,000 US dollar / annum. The National production potential for cocoa pod husk is put at 450,000 tonnes and is capable of grossing between $2 and 2.7 million US dollars annually, given estimates of 15% and 20% income of the cost of production. The results of the table are graphed in figure 1. From figure 1, it can be observed that the disparity between the highest 7 states and the remaining recognized cocoa producing states are high 96% of the income will be generated by the highest 7 states.

Figure 1



Conclusion and Recommendation

Based on the results of the study, it can be concluded that the present available resources for cocoa production is highest in 7 state which are in the order of magnitude, Ondo, Cross Rivers, Osun, Ogun, Ekiti, Edo and Oyo State. Nigeria has a potential for producing organic fertiliser which is considered to be of various benefits especially health wise and the ability to promote long sustained nutrient fertility. If resources are properly harnessed, the country has the potential to earn a conservative income between 20 to 27 million US dollars per annum from a resource which is currently wasting away on farms. Government should encourage production advantage among cocoa producing states, while looking for new plantations to create.

Results of this study gives an inkling to small and medium scale private investors that there is a resource available in Nigeria that is begging to be attended to. This is important taking into consideration the 10 point agenda of the Federal Government of which empowering entrepreneurs to invest in Nigeria is one of the goals, thereby ensuring wealth creation.

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Experimental Title: Economics of pest control in cocoa production in Oyo state, Nigeria

(Oluyole, K.A. and
Adejumo, M. O.)

Introduction

Nigeria as a developing country was rated the second largest world producer of cocoa in 1960s (Adegbola and Abe, 1983), and for a long period, the crop has been generating substantial foreign exchange earnings for the country. However, the production of this important cash crop for export has suffered a reduction in the recent years in the country. The reduction was due to among other things the pest and diseases which are capable of destroying more than half of the production (Anonymous, 1979; Lawal *et al*, 2005). The main insect pests of cocoa are capsid bugs, shield bugs and mealy bugs. In addition, epiphytes, various weed species and common diseases like blackpod are also significant constraints (Dormon *et al*, 2007). These pests are effectively controlled by chemical method of pest control (Tijani, 2005; Eguagie, 1974; Idachaba and Olayide, 1976; Aina, 1992).

Insect pests such as capsid bugs (*Heteroptera myriad*) as well as shield bug (Bathycoelia thalassina) are better controlled with synthetic insecticides (Owusu-manu, 1977). Whereas blackpod disease, a major disease of cocoa which causes pod rottening is better controlled by removing diseased pods and/or applying fungicides during the raining season (Akofi *et al*, 2003). The mistletoe is a parasitic plant found in some forest trees including cocoa. They affect yields by extracting water and nutrients from the cocoa plant and eventually, may kill the plant (Wilson, 1999). The recommended control measure is to remove the parasite manually with cutlass or prunners. Other types of parasites such as epiphytes are also controlled by removing them with cutlass or prunner. Weeds which are described as unwanted plants compete with cocoa for soil nutrients. This is controlled with synthetic pesticides (herbicides) or the use of manual control (weeding). It should be noted that the cost of procuring these chemicals is very high in as much that some of the chemicals are imported. In fact, 95% of agro-chemicals used in Nigeria are usually imported thus escalating their

prices (Ikemefuna, 1998). Therefore, the cost of the chemicals vis-à-vis the overall cost of controlling the pest are hereby adding to the cost of production, thus reduces the gross margin. Against this background, this study examined the economics of pest management practices in cocoa production in the study area. Specifically, it identified the socio-economic characteristics of the farmers, the pest control method adopted by the farmers, the cost incurred in these pest management practices as well as the effect of pest management costs on the gross margin of the farmer.

Methodology

The study was carried out in Oyo state of Nigeria. Oyo state is one of the cocoa producing states in Nigeria. Three cocoa producing Local Government Areas (LGAs) in the state were selected for the study. The LGAs are Ido, Oluyole and Ona Ara. In each LGA, two communities were randomly selected making a total of six communities selected for the study. The communities randomly selected are Oloka, Baale Sango, Abanla, Onigambari, Gbedun and Ajia. From the six communities, a total of eighty respondents were randomly selected for the study. The selection of the respondents from the communities was proportionate to the size (population) of the cocoa farmers in each community. Information was collected from the respondents with aid of structured questionnaire. The collection of the information was done between October and November, 2007.

The data from the information collected was analysed with descriptive statistics, budgetary analysis as well as multivariate analysis.

(i) Descriptive statistics- frequency and percentages were employed here to analyzed the socio-economic characteristics of the respondents.

(ii) Budgetary analysis- this was used to estimate the gross margin of the farmers.

$TC = TFC + TVC$

$GM = GR - TVC$

$NI = GM - TFC$

$GR = \text{Total Output} \times \text{Unit Price}$

Where:

TC = Total Cost
TFC = Total Fixed Cost
TVC= Total Variable Cost
GM = Gross Margin
GR = Gross Revenue
NI = Net income

(iii) Ordinary Least Square (OLS) Regression model- this was used to estimate the effects of the cost of pest management on the gross margin of the farmers.

Explicitly, the model is expressed thus:

$$\ln GM = \beta_0 + \beta_1 \ln COCHE + \beta_2 \ln LACHE + \beta_3 \ln EQCHE + \beta_4 \ln LAPHY + \beta_5 \ln MAPHY + e_i$$

Where:

GM = Gross Margin (N),
COCHE = Cost of pest control chemicals (N),
LACHE = Cost of labour for chemical control (N),
EQCHE = Cost of equipment for chemical control (N),
LAPHY = Cost of labour for physical control (N),
MAPHY = Cost of material for physical control (N),
ln = Natural logarithm,
βs = Estimates of the regressors,
ei = Stochastic random error term.

Results and Discussion

Table 1 shows that majority (91.3%) of the respondents were males while just 8.7% of the respondents were females. This showed that majority of cocoa farm owners were males in the study area. However, this does not mean that not many women are involved in cocoa production. It could also be observed in Table 1 that majority (83.7%) of the respondents were above fifty years of age. The implication of this is that while the development might have a positive impact on the farming experience, the old age may reduce the vigour with which a farmer can work thus reduces the efficiency of the farmers. Table 1 also showed that most (51.2%) of the

respondents had formal education. This may have positive impact on cocoa production in the study area. The study also revealed that majority (93.7%) of the respondents had more than ten years farming experience. Long years of farming experience may increase the efficiency of farmers thus enhances increased production by the farmers. Table 1 also revealed that all the respondents were using both the physical and chemical methods to control pests on the farms while none of the respondents is using biological method.

Table 2 shows the summary of the pest management costs and returns from cocoa production. The results show that the total variable costs was ₦3,651,300 while the average variable cost per farmer was ₦45,641, the average fixed cost and the average gross revenue were ₦10, 093 and ₦99,369 respectively. The total cost involved in pest management and the gross revenue derived were ₦4,458,750 and ₦7,949,500respectively while the average total cost per farmer and the average gross revenue per farmer were ₦55,734 and ₦99,369 respectively. The proportion of the total cost to the gross revenue therefore was 56.09%. Hence, 56.09% of the gross margin was expended on pest management of cocoa in the study area. The cost include the cost of purchasing pesticides such as fungicides (for the control of blackpod disease of cocoa); insecticides (for the control of insects); weedicides (for the control of weeds); cost of labour for the application of these pesticides; cost of equipment/materials used in spraying these chemicals and the cost of labour used for manual clearing of weeds, cutting of mistletoes as well as physical removal of bryophytes.

The effect of the cost of pest management on the gross margin of the farmers was shown on Table 3. It shows that the coefficient of the cost of pest control chemicals, cost of labour for chemical control and cost of labour for physical control are all negative and significant ($P<0.01$, $P<0.05$ and $P<0.05$ respectively). The coefficient of the cost of equipment for chemical control is also significant ($P<0.05$) but is positive. However, the coefficient of the cost of materials for physical control is not significant. This shows that all the pest management costs, that is, cost of pest control chemicals, cost of labour for chemical control, cost of equipment for chemical control and the cost of labour for physical control are important determinants of gross margin in cocoa production in the study area. The negative sign of COCHE, LACHE and LAPHY shows that as expenditure on these cost items increases, gross margin decreases. In the case of the cost of equipment for chemical control (EQCHE), an increase in it brings about an increase in the gross margin.

Elasticity of pest management costs

The elasticity of the cost of pest control chemicals (COCHE), cost of labour for chemical control (LACHE), cost of equipment for chemical control (EQCHE), cost of labour for physical control (LAPHY) and the cost of materials for physical control (MAPHY) are -0.512, -0.074, 0.086, 0.311 and 0.185 respectively. This however means that there is a decrease of 0.512%,0.74% and 0.311% in the gross margin of the farmer with 1% increase in COCHE, LACHE and LAPHY respectively. Also, there is an increase of 0.086% and 0.185% in the gross margin with 1% increase in EQCHE and MAPHY respectively. The interpretation of this is that it is the cost of pest control chemicals that the gross margin is mostly responsive to followed by the cost of labour for physical control while the cost of labour for chemical control that the gross margin is least responsive to.

Conclusion

Majority (83.7%) of the farmers in the study area were already old (above 50 years of age). This is a pointer to a reduced productivity because there will be a reduction in the vigour with which a farmer with an old age can work, thus reduces

the efficiency of the farmers. Most (51%) of the respondents had formal education. This is an indices towards an efficient production of cocoa in the study area as literate farmers would find it easy to understand and adopt new technologies on their farms (Oluyole 2005). All the farmers were practicing both the physical and chemical methods of pest control but none of the farmers was practicing biological method of pest control in the study area. The proportion of the total cost of pest management of cocoa to the gross margin derived from cocoa production by the farmers was 56.09%. Pest management costs such as cost of pest control chemicals, cost of labour for chemical control, cost of equipment for chemical control and the cost of labour for physical control are critical costs affecting the gross margin of cocoa production in the study area. The elasticity of production for cost of pest control chemicals, cost of labour for chemical control, cost of equipment for chemical control, cost of labour for physical control are -0.512%, -0.074%, 0.086%, -0.311% and 0.185% respectively. Hence, it is the cost of pest control chemicals that the gross margin is most responsive to.

Based on the findings, it could be concluded that the cost of pest management of cocoa in the study area is economical; hence the cocoa farmers there are cost effective in terms of the pest management.

Recommendations

1. Youths in the study area should be encouraged to take up cocoa farming career. This is quite imperative as most cocoa farmers there are already old. The encouragement package could be inform of granting soft loan.
2. There is a need to train farmers on the need to adopt biological method of pest control. This is necessary as there was no farmer that adopted the method on their farm. Biological method of pest control is much more sustainable than any other method of pest control.
3. Farmers should organize themselves into cooperative societies. This would make it easy for them to be able to obtain inputs such as agro-chemicals (fungicides, insecticides and weedicides) at reduced prices from government.

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Table 1: Demographic variables of the respondents

Variables	Frequency	Percentages
Sex		
Male	73	91.3
Female	7	8.7
Total	80	100.0
Age (years)		
<30	0	0
30-39	1	1.3
40-50	12	15.0
>50	67	83.7
Total	80	100.0
Educational Level		
No formal education	39	48.8
Primary education	34	42.5
Secondary education	7	8.7
Tertiary education	0	0
Total	80	100.0
Farming Experience (years)		
<10	5	6.3
10-20	16	20.0
21-30	28	35.0
>30	31	38.7
Total	80	100.0
Pest Control Method Adopted		
Physical method	80	100.0
Chemical method	80	100.0
Biological method	0	0

Source: Field survey, 2007

Table 2: Cost and Returns Analysis

S/N	Item	Amount (N)
1.	Total Variable Cost	3,651,300
2.	Average Variable Cost/farmer	45,641
3.	Total Fixed Cost	807,450
4.	Average Fixed Cost/farmer	10,093
5.	Total Cost	4,458,750
6.	Average Total Cost/farmer	55,734
7.	Gross Revenue	7,949,500
8.	Gross Revenue/farmer	99,369
9.	Gross Margin	4,298,200
10.	Gross Margin/farmer	53,728
11.	Net Income	3,490,750
12.	Net Income/farmer	43,634

Source: Field Survey, 2007

Table 3: Result of Regression Analysis

Variable	Estimate	Standard error	t-ratios
Constant	5.634	0.092	4.103**
lnCOCHE	-0.512	0.104	-3.331***
lnLACHE	-0.017	0.054	-2.611**
lnEQCHE	0.086	0.112	2.607**
lnLAPHY	-0.311	0.014	-3.232**
lnMAPHY	0.185	0.056	0.956
R^2	0.75		
F	3.62		
D-W	2.33		

Source: SPSS Computer Analysis printout
*** Significant at 1% level,
** Significant at 5% level.

FARMING SYSTEM AND EXTENTION

Experimental Title: An assessment of gender involvement in kola production in Osun State, Nigeria (Adebiyi, S and Oluyole K.A.)

Introduction

Kola which belongs to the family sterculiaceae, has long history in West Africa, its use features prominently in religious, social and ritual activities of West Africa. They are found relevant in ceremonies related to marriage, child naming, funerals and in consulting various gods and goddess as the case may be. Johannas Leo Africanas was the first person to refer to kola nut in 1591. The Portuguese, Odorado Lapez recorded the occurrence of kola tree in Congo in followed by Andre Alvares, who saw them in Gambia and Guinea in 1954 (Opeke, 1987). Subsequently, the tree was recorded along the West Coast of Africa from Gambia to Angola. *Cola nitida* was originally distributed along the West Coast of Africa from Sierra-Leone to the Republic of Benin (Opeke, 1987) with highest frequency and variability in the forest area of Ivory Coast (now cote D'Ivoire) and Ghana. This area remained for long the only source of kola nuts to the West African trade routes. The importance of kola nut to Nigerian economy cannot be over-emphasized, kola nut as a tropical tree crop has over twenty species, out of these *cola nitida and cola acuminata* are the only species grown on large scale in Nigeria. Out of the two species, *cola nitida* is being traded internationally, while the consumption of kola acuminate is confined to Southern Nigeria. Before the dependence of the economy on crude oil, the place of kola nut cannot be over-empasized (Akinbode 1982). Out of the three components of kola fruit (pods) that is kola pod husk, kola testa and nuts, only the nut has been found of high economic use, either in Nigeria or in the developed countries. It was estimated that Nigeria produces about 127500 tons of the fresh nuts annually; representing 70% of the world production (Pala, 1976) about 90% of this amount is consumed in Nigeria and some neighbouring West African Countries (Van Eijinatten, 1964). It was also estimated that the internal kola nut market in Nigeria worth's about N30 million (Pala, 1976). In 1970, kola nut exports fetched N126,000 to Nigerian government. Kola pod husk, which has been considered wasted on the farm in the past, has been processed as diet, this ensure 60% replacement of maize in poultry feed formulation. Also, kola testa, which is ound in small quantity, has been used in some feed formulation (Hamzat and Jayeola, 2002). This showed that the whole kola fruit has considered economic uses. Prior to the colonization of most African countries, tree cropping was mainly undertaken by men folk. But studies, such as Pala (1976) and Mertha (1982) have shown that colonial economy adversely affected traditional pattern of task allocation. These writers noted that the distruption of the pre-colonial division of labour between sexes in the rural communities, as a result of male absenteeism from the countryside. In line with the fact that wage employment draws men away from their own farms, and western education changing men's attitude about agriculture, many women were found doing what was traditionally meant for men. In several parts of sub-Saharan Africa, women undertake up to 70 percent of production, processing and marketing of agricultural products. In kola production, there are different stages involved; and in each stage both men and women are involved but in some cases in different intensities. This study examines the extent of gender involvement in kola production in the study area.

Methodology

The study was carried out in five local government areas of Osun State, Nigeria between June and July 2007. The sampled Local government areas are Ede North, Ife North, Ife South, Iwo and Osogbo. A total of two hundred respondents were randomly selected from the study area at the rate of forty respondents per

local government area. Information was collected from the respondents with the aid of structured quenstionnaires. Questions such as age, educational level, farm owenership pattern, marital status, gender, stages involved in kola nut production as well as the problems encountered in the course of their work were asked. The data obtained from the information collected was analyzed using descriptive statistics.

Result and Discussion

Social-economic and demographic characteristics of the respondents.

Table 1 shows that 83.6% of the respondents were male while 16.4% were females. This shows that there were more males in the study area than females. The implication of this is that there would be more hands to do tedious operations in kola production. Such tedious operations could include clearing, chemical application as well as harvesting. All these operations require much strength, which could easily be provided by the males. Table 1 also showed that 75.4% of the total respondents acquired their farmland through inheritance. Out of this, 72.7% of them were males while 2.7% were female – showing that there were more males involving in acquiring farmland through inheritance than females. Also, 3.6% and 7.3% of the respondents acquired their farmlands through purchases and rented on yearly basis respectively. The result however revealed that inheritance is the land ownership pattern that is common in the study area. The age distribution shows that 70.9% of the respondents are above 56years of age while 29.1% of the respondents are above their active stage. This may have negative impact on the farm size as age people may not have enough strength to cultivate large farms. However on the other hand, the development may have positive impact on the farming experience. Older farmers would have more experience than the younger ones. Table 1 also showed that 85.4% of the respondents were married while the rest were not married. The implication of this finding is that there is possibility of more availability of family labour. As regards the educational level of the respondents, Table 1 showed that 66.4% of the respondents had no formal education while 33.6% had formal education. Hence majority of the respondents had no formal education. This may reduce the respondent's efficiency as only few of them may be able to adopt and practice new technologies on their farm.

Gender involvement in production stages of kola nut

Table 2 shows that five stages of production were identified in kola production. The stages are farm clearing, chemical application, harvesting, on-farm processing and kola nut preservation. The result shows that 83.6% of the respondents involved in farm clearing were male while 16.4% were female. Hence, more males were involved in farm clearing than females. This is quite obvious because farm clearing is a tedious operation, hence not many females will be able to have enough strength to carry out the operation.

Table 2 also shows that 81.8% of the respondents involved in chemical application were males while 18.2% were females. Therefore, there were more males involved in chemical application than females. The finding is logic in as much that chemical application also required much strength which could only be provided by males. 74% of the respondents involved in harvesting were males while 25.5% of the respondents were females. Hence, more males were involved in kola nut harvesting team than females. However, it could be observed in Table 2 hat 89.1% of the total respondents involved in on-farm processing were females – while just 10.9% were males. Hence, on farm kola females in the study area mostly undertake processing. As regards preservation of kola nut, 70.9% of the respondents that were involved in this operation were females while 29.1% were males showing that there were more females involved in this operation than males.

It could be observed that females mostly undertook on-farm processing as well as preservation operations. This is quire obvious in as much that these operations do not require much strength hence more females would find it so easy to undertake them. Meanwhile, some of the problems faced by the respondents in the course of their work are lack of capital, lack of good storage facilities, lack of good roads and fluctuations in price.

Conclusion

There were more male respondents (83.6%) than female respondents (16.4%) in the study area. Most (66.4%) of the respondents had no formal education while only 33.6% of the respondents had formal education. The identified stages in kola nut production in the study area are farm clearing, chemical application, kola nut harvesting, on-farm processing of kola nut as well as kola nut preservation. More males were involved in farm clearing 83.6% chemical application (81.8%) and harvesting (74.5%) while there were more females involved in on-farm kola nut processing (89.1%) as well as kola nut preservation (70.9%).

Recommendations

1. Illiterate farmers among the respondent should be encouraged on their need to acquire formal education, as this would make them to be more efficient in their production. The encouragement could be inform of granting free adult education.

2. Policies to make loans available to farmers should be initiated, as the importance of capital cannot be over emphasized in kola nut production.

3. Improved processing methods geared towards improved storage and enhancement of the nutritive value of kola nut should be introduced in the study area.

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FIGURES AND TABLES

Characteristics	*Male*		*Female*	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Gender	167	83.6	33	16.4
Ownership pattern				
(1) Inheritance	145	72.7	5	2.7
Purchased	7.0	3.6	7	3.6
Rented on yearly basis	15	7.3	20	10.0
Age Distribution of respondents				
26 – 35	7	3.6	2	0.9
36 – 45	15	7.3	4	1.8
46 – 55	27	13.6	4	1.8
56 – 65	54	27.3	9	4.5
Above 65	64	31.8	15	7.3
Marital Status				
Single	5	2.7	0	0
Married	162	80.9	9	4.5
Widowed/Separated	0	0	24	11.8
Educational Level				
No formal Education	113	56.4	20	10
Adult literacy school	22	10.9	5	2.7
Primary Education	18	9.1	4	1.8
Secondary Education	11	5.5	2	0.9
Tertiary Education	0	0	0	0

Source: Field survey, 2007

Tale 2: Stages in kola nut production

Stages	Male		Female	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Farm clearing	167	83.6	33	16.4
Chemical application	163	81.8	37	18.2
Harvesting	149	74.5	51	25.5
On farm processing	21	10.9	179	89.1
Preservation	58	29.1	142	70.9

Source: Field survey, 2007

CASHEW PROGRAMME

Experimental Tittle: Insect pests encountered in a cashew plantation in Ibadan, Nigeria (Mokwunye, I.U. and. Okelana F.A and J.C. Anikwe)

Introduction

The cashew plant, Anacardium occidentale (Anacardiaceae) is a perennial crop that is cultivated in the tropical humid climate (Akinwale and Esan, 1989). It was introduced into Nigeria by Portuguese traders around the $15^{th}/16^{th}$ century (Ohler,1988). Its cultivation was also considered essential for tree cover in eroded areas where land reclamation programmes were under way to prevent further erosion (Dwonmoh et al.2008). Cashew is potentially a great socio-economic crop to Nigeria.

A myriad of insect pests have been found to attack cashew like many other tree crops. However, very few are observed to cause economic damage in Nigeria. These include the longhorn beetle-Analeptes trifasciata Fabricius (Coleoptera: Cerambycidae) which girdles stems and branches, the red-banded thrips – Selenothrips rubrocinctus. Giard (Thysanoptera: Thripidae) which attack the leaves and the fruit scrapper – Pachnoda cordata Drury (Coleoptera : Scarabaeidae) in descending order of importance (adeyemo and Okelana 1989). A lot of these insect pests associated with cashew are yet to be identified as well as their damage potential which is yet to be estimated. Adeyemo and Okelana (1989) reported that the three major insect pest of cashew were Analeptes trifasciata, Selenothrips rubrocinctus and Pachnoda cordata. In 2006, the cashew leaf miner, Acrocercops syngramma was reported as having reached a major pest status while in 2008, the incidence of cashew stem borer, Plocaederus ferrugineus as an emerging major cashew pest and its management has been reported (Anikwe et al., 2008 (in press). The alarming rate of dieback of cashew seedling at CRIN nursery coupled with various unidentified damage characteristics found on well established cashew stands in the plantations which include twig dieback which has been found to be caused by Helopeltis spp as reported by Mokwunye (2008 (personal comm.), sudden death of trees, fruit and flower shedding, snapping of trunks and branches and boring of branches have all been observed. These observations which are different from the ones earlier reported necessitated this she study was conducted on a 1ha cashew plantation located at the CRIN Headquarter in Ibadan. The cashew plantation was established in 2005 and planted in geometry of 6m by 6m with a total of 320 stands. Ibadan has an annual rainfall average of 2000mm with a bimodal pattern. CRIN is located in the humid rainforest ecosystem with mean solar radiation of $18mj/m^2/day$. It lies between the latitude 7^o 30'N and longitude 3^o54'E at an altitude of 200m above sea level.

Twenty mature trees are randomly sampled on a fortnightly basis from the base to girth at breast height of 1.5m for insect pests. Insects were collected from the stem, branches, twigs, underneath the leaves, fruits (young and mature apples and nuts), and inflorescences. Flying insects were collected by means of sweep nets. Various insects collected from the trunks, branches, leaves were carefully brushed with a camel brush into a 2lb kilner jar embedded with cotton wool soaked with ethyl acetate. All developmental stages of insects (eggs, larvae, nymphs, pupae and adults) were recorded Panicles and fruits (apples and nuts) were considered damaged when there are symptoms of brownish and watery lesions, necrotic lesions, dieback and fruit deformation with scars. In another occasion, symptoms were later confirmed in the laboratory when live and yet-to-be identified insects were taken to the laboratory, reared and provided with various parts of the plants as food source to establish which pest was causing which specific damage. Insects knocked off in ethyl acetate were later identified at the insect collection Centre of CRIN, Ibadan. Climatic data such as temperature, relatice humidity and rainfall were obtained from daily

and weekly from meteorological data collected from the meteorological station of CRIN located 1km from the experimental site. Monthly mean separation of data collected on the insect fauna of cashew was done using the Genstat Edition 3.

Results and Discussion

Several species of insect pests were identified on cashew while some were widely distributed others were occasionally found. Most of the insect pests damaged the crop by sucking sap, branch girdling, stem boring, defoliation and boring. The incidence of most insect pest recorded during the period of survey was higher at the onset and during of the rainy season, this can be attributed to the abundance of food source and breeding sites due to the favourable climatic condition.

The major apple feeders observed were *Smaragdesthes guerini, s. Africanus, Gametis sanguinolenta, Pseudotheraptus devastus and Pachnoda cordata* Drurry (Coleopteran: Cetoniidae). Prominent among the pseudo-apple feeders was *Pachnoda cordata*. They were usually abundant between April and May feeding on young fruits and nuts, thereby predisposing them to secondary infestation by *Drosophilia spp*. and rot organisms. It was not uncommon to encounter fresh termite infestation and grasshopper especially during the dry season. The predominant species were *Analeptes trifaciata F., Helopeltis spp., Acrocercops sunagramma, Meyrick, Sylepta derogator and Parapoderus spp*. The most devastating species belonged to the order Coleptera which includes the stem girdler, Analeptes trifasciata F. (Coleoptera: Lamiidae). The stem girdler, *A. trifasciata* was prevalent during the dry season attaining a mean peak population of 31.0 in November, 2006. This coincided with the period of low rainfall distribution (2.6mm) and relative humidity (65.5%). This agres with the works of Igboekwe (1983), who observed that the activities of the beetle were predominant between October and December. Topper et. Al.,(2001) reported that the insect is a major problem on cashew farms in some West African Countries including Nigeria. It was the most common and destructive beetle. They were usually observed girdling the branches to provide suitable breeding site for the larvae in form of dead wood.

The stem and root borer, *P. ferrugineus* was comparatively low with an uneven pattern of distribution. It attained the highest mean population value of 3.0 in May, 2006. It was often characterized by the presence of frass (mixture of wood shavings and gum from the cashew tree) exuding from the tree due to the larvae feeding activities at the base of the tree. Main symptoms of attack are yellow of leaves, drying of twigs, presence of holes at the base of stem with exuding sap and frass followed by death within weeks. Anikwe et al., (2008) reported the incidence of this previously unknown insect pest in Ibadan. Its occurrence was observed to be isolated and uncommon.

Prominent among the sap sucking insect pests was *Helopeltis* which was prevalent throughout the period of survey with mean peak population of 24.6, 19 and 43.3 in June 2006, July 2007 and June 2008 respectively. This corresponded to the period of high rainfall distribution pattern and high relative humidity as well. According to AIC (2002), the population of *Helopeltis* builds up during the rainy season, as observed in this study. They appear to undergo several generations per year and are thus present in cashew plantation throughout the year under favourable conditions. Topper et al.,(2001) recorded the presence of *Helopeltis* in some parts of Nigeria though in low population at the period of survey.

Several species of *Helopltis* have been recorded on a vast number of plants in the Tropical, Oriental and Australian regions (Xianli and Van Der Geest, 1990; Stonedahl, 1991, Peng et al., 1995 and Dwomoh et al ., 2008). In Nigeria, *H. bergrothi* has been reported to attack cocoa pods even though it is present in low population. In Ghana, two species *H. bergrothi* on cocoa and *H. schoutedeni* on cashew were reported by Forsyth

(1966). Boakye (1995) and Dwomoh (2008). This finding confirms that *Helopeltis* is a common pest of cashew growing communities of the world.

Helopeltis nymphs and adults suck leaves, young shoots, inflorescences, even young apples and nuts (Ranaweera, 2000). Field observation confirmed that fresh damage symptoms mostly occurred on young leaves, tender stems and tender flower terms. Severe attack of shoot may cause dieback due to bug silva in combination with fungi infection (Ohler, 1988; TAS, 2000, AIC, 2002). It is known that disease infections can reduce the vigour of plants and enhance their susceptibility to termite attack. In the order Hemiptera, minor insects observed were *Anoplocnemis curvipes F., Pseudotheraptus devastans Dist., Homoecerus pallens F., Aspavia armigera F., Atelocera spinulosa and Dysdercus superstitiosus*. However, they were not significant in terms of damage and occurrence.

Fresh synptoms of *Acrocercops syngramma* Meyrick, commonly known as the cashew leaf miner was observed throughout the period of investigation especially between the months of June and September. The highest mean population value of 30.6 was observed in June 2008. The symptoms of infestation, i.e. mined portions on leaves were mainly dominant during the wet season when there is abundance of new flushes and this is in line with earlier works. Adeyemo and Okelana, (1989) reported that they usually appear during the period of new flushes. It was also observed that attack is more severe on young plants. It is increasingly becoming an insect pest of economic importance in cashew plantation; this corroborates the findings of Okelana and Anikwe (2006) who reported the emergence of *A. syngramma* as a major pest on cashew.

Damage is caused by their larvae which destroy the adaxial and abaxial surfaces of young leaves by making serpentine tunnels called mines. Through, the leaf miner does not directly attack the fruit, but the reduction of the leaf photosynthetic area may adversely affect the physiological functioning of the plant depending on the severity. Other defoliators such as *Parapoderus spp*, *Lema tibialis,*and *Zonoverus variegatus* were often observed feeding on leaves. *Parapoderus spp* usually scrapped the epidermis of the leaves. The feeding signs is characterized by small circular holes on leaves which will dry up and fall. The symptoms of infestation of *Sylepta spp* and *Euprotis fasciata* is the presence of rolled leaves by their larvae. They usually attack young tender leaves which eventually dry up and fall.

Conclusion

The survey identified a few beneficial insects species on cashew. They include preying mantids and various ant species.

This study has shown the relative importance of observed insect pests and also provided a baseline information on the ecology of insect pests attacking cashew in Nigeria and this is critical to the development of sound and sustainable control options. Rainfall and humidity strongly interacted with other parameters to determine the population of these observed insect pests. In most of tropical regions, rainfall and relative humidty are the major factors influencing the development of insect population, far exceeding the influence of temperature (Eikinton, 1993; Babib et al., 2007).

Table1: Insect species associated with cashew, their seasonal abundance and damage characteristics in Ibadan, Nigeria.

Figure 1: Seasonal distribution of some selected insect pests associated with *A. occidentale*. In CRIN, Ibadan

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FIGURES AND FIGURES

Insects Order/family/genus/species	Period of abundance	Parts attacked and Damage Characteristics
Parapoderus spp (Coleoptera: Curculionidae)	April-June	Found on young and mature trees. Adults feed on tender foliage
Zonocerus variegates L. (Orthoptera: Pyrgomorphidae)	October – March	Found on both the young and mature trees. Foliage feeders
Pachnoda cordata Drury (Coleoptera: Cetoniidae)	April – May	Found on mature trees, adults feed on young and mature apples, predisposing them to secondary infestation by Drosopholia

		spp
Homoecerus pallens F. (Hemiptera: Coreidae)	April – June	Found on young and mature trees. Adult suck sap and juice from shoots, young apples and nuts
Smaragdesthes guerini (coleopteran)	April – July	Found on young and mature apples.
Sylepta derogate F. (Lepidoptera: Pyralidae)	January – May	Found on young and mature trees. Lays eggs in olled up leaves. They are shoot feeders
Lema tibialis (Coleptera: Crioceridae)	April – June	Found on both young and mature trees. Adults feed on tender shoots
Helopeltis spp (Hemiptera: Miridae)	January – August	Found on shoots. Inflorescences, fruits and young nuts. They cause dieback in severe cases
Analeptes trifasciata F. (Coleoptera: Cerambycidae)	September – January	Found on mature trees. Adults girdle stems and branches in a V-shape, which eventually breaks off
Smaragdesthese africanus	April – July	Found on young and mature fruits. Adults feed on fruits, Feeding

		predisposes fruits to rot organism and Drosophilia spp
Marcrotermes bellicosus S. (Isoptera;)	September - April	Found on the trunk and root of young and mature trees. They tunnel into the root and distort the conducting tissues and also create entry points for rot organisms
Atelocera spinulosa (Hemiptera: Pentatomidae)	June – August	Found on mature trees Nymphs and adults suck flushing shoots and growing tips thereby weakening the plant
Plaesiorrhina recurva (Coleoptera)	January - May	Found on fruits. Fruit feeders. Feeding predisposes fruit to rot organism
Anoplocnemis curvipes F. (Hemiptera: Coreidae)	October - February	Found on mature trees. Both nymphs and adults suck juice from young flushes, developing fruits and nuts. Damaged foliar, apples

		and nuts turn pale green and wither
Dysdercus superstitiosus F. (Hemiptera: Pyrrhocooridae)	April - August	Adults and nymphs suck shoots and branches at the tips
Acrocercops syngramma Meyrick (Lepidoptera: Gracilariidae)	June - August	Found on tender leaves. Larvae mine into tender leaves, leaving tortuous markings. The thin epidermal peel swells up and eventually, the mined area dries up and falls
Plocaederus ferrugineus L. (Coleoptera: Cerambycidae)	Any time of the year	Attacks base of trunks of cashew tree. Larvae feed bore into wood tissue and feed on the sapwood
Leptoglossus membranaceus F. (Hemiptera)	January - April	Found on leaves. Sapsucker
Pseudotheraptus devastans Dist. (Hemiptera: Coreidae)	March - April	Found on both young and mature trees. Adults suck sap and juice from shoots, apples and nuts. Point of stylet insertion develops necrotic lesions that
		appear black, sunken, elongated spots on the epidermal tissue
Aspavia armigera F. (Hemiptera: Pentatomidae)		Found on both young and mature trees. Sap Feeders

TABLE 2: Mean values of temperature, relative humidity and rainfall at CRIN Headquarters from 2006 -2008

Month	Mean Temperature%	Mean-relative humidity (%)	Mean rainfall (mm)
April 2006	24	74	104.4
May 2006	23	79	86.9
June 2006	23	83	244.5
July 2006	24.5	86.5	118.5
August 2006	23.5	91	93
September 2006	22.5	86.5	260
October 2006	23.5	83	166.2
November 2006	24	65.5	2.6
December 2006	23	64.5	0
January 2007	21.5	45.5	0
February 2007	26.5	57.4	28.8
March 2007	27	59	25.7
April 2007	27	70	49.1
May 2007	25.5	75	151
June 2007	25	80.5	221.7
July 2007	24.5	86.5	242.8
August 2007	23.5	85	150
September 2007	24	83.5	230.1
October 2007	23.5	79	156.1
November 2007	25.5	77.5	42.6
December 2007	25	74	4.9
January 2008	23.5	47.2	0
February 2008	24.5	45.8	0
March 2008	25.5	70.8	41.6
April 2008	25.2	72.4	23
May 2008	25.1	73.2	42.9
June 2008	25	77.7	224.9

Experimental Title: Constraints of farmers in cashew production: A case study of Orire L.G.A. of Oyo State, Nigeria. (Uwagboe, E.O.)

Introduction

Various constraints are militating against the production, marketing and processing of cashew in Nigeria. Ayodele (1999) identified the following constraints of cashew in Nigeria; land acquisition (about 60% of Nigeria cashew nut production is attributed to small-scale farmers who manage between 2 and 4ha of cashew farm), unavailability of labour, lack of processing technology, high cost of production, unstable market system, high interest rate, low funding, inadequate infrastructural facilities such as rural roads, electricity, water supply and poor extension services.

However, recent studies have identified various constraints militating against cashew fruits production which varies from one place to the other. Hence the need to examine the constraints of cashew production among farmers in Orire L.G.A. of Oyo State which is the main objective of this study.

Objective of the study;

1. Identify the socio-economic characteristic of the respondents in the study area.
2. Examine the farming activities of the respondents in the study area and;
3. Examine the constraints of cashew fruits production in the study area.

Methodology

Purpose sampling technique was used to select Orire block as a major cashew producing area in Ogbomoso zone of the Oyo State. Agricultural Development Programme (OSADEP). Five villages namely; Iliju, Ahoro, Oko, Egbejoda and Ahoro Dada were selected from the fourteen cashew producing villages identified in the area with simple random sampling technique. Detailed questionnaire were administered to one hundred and ten respondents on proportional basis using systematic sampling technique with the list of ADP contact farmers. Data were analysed using frequency counts, percentages and Pearson Product Moment Correlation (PPMC) with SPSS 11.0 Windows.

Results and Discussion

Selected personal characteristics

The selected personal characteristics of the farmers are presented under the following sub-headings: Age distribution of the respondents. Sex and educational level.

Age is an important factor in farm work. Increase in number of years of farming might result in additional experience of the farmer, to improve upon their level of productivity and income. The result on Table 1 shows that most (52.70%) of the respondents were between the age range of 30 and 49 years, 44.60% were above 50years while 2.70% at less than 30years. This implies that most of the cashew farmers in the study area were in their prime age and could be vulnerable to rural-urban drift in search for white collar jobs which can adversely affect cashew production

Cashew farming requires labour, which is also gender sensitive. Table 1 shows that most (84.50%) of the cashew farmers are males while 15.50% are females. The male domination of cashew farming activities as observed in the study area could be attributed to the fact that women age given opportunity to cultivate arable crops on their husband's plots while access to permanent crop production is usually restricted to men (Abubakar, 2003)

It is generally believed that farmer's level of education would enhance their farming activities and level of awareness. Most (57.30%) of the respondents have no formal education while 28.2%) had primary education only few (10.00%) and 4.50%) of the respondents have secondary and tertiary education respectively (Table 1), which is an indication that the farmers

level of education in the study area is very low which could affect their level of receptivity of improved technologies. Poor adoption of improved technologies could reduce their yield and consequently result in low income of the farmers.

Farming Activities:
As indicated in Figure 1, most (65.50%) of the respondents cultivated less than 6ha of farm land. It also shows that 25.50% of the respondents cultivated between 6 and 9.99ha while 9.00% cultivated 10ha and above. It can be deduced from the finding that majority of the respondents are small scale farmers cultivating less than 6ha which is in agreement with Olayide (1980) finding that majority of farmers in Nigeria are small scale farmers as they cultivate less than 10ha of farm land.
This could be due to problems such as inadequate access to natural resources including land, capital, composite farm policy of the government, inefficient system e.t.c (Akinwale and Ayodele, 1999).

Varieties of Cashew Used for Planting
Table 2 reveals that most (80.90%) of the cashew farmers used local varieties (Ogbomoso varieties) which could result to smaller nuts and low income, as their produce could not meet up with the required standard grade for export. Olunloyo (1996) reported that the large size of nuts are more acceptable for export. Therefore the numbers of nuts for each 1kg should not count more than 160-200nuts. Any sample collected which counts more than this limit per kg will attract lesser price while counting below 160 normally attract additional price.

However, few (9.10%) and 10.00% used CRIN improved varieties and Brazillian Jumbo nuts respectively. This is an indication that majority of the cashew farmers do not use improved varieties and this results in poor yield and will affect their income.

Constraints experienced by cashew farmers
Table 3 reveals that most (70%) of the respondents ranked inadequate capital as the most severe constraints while lack of storage facilities was ranked by few (5.5%) of the respondents as serious constraints. This implies that cashew farmers in the study area could have found it difficult to obtain loan from banks that will require collateral to enhance increase in their cashew production which would increase their level of income. Storage facilities as the least constraints could be attributed to the fact that the cashew farmers do not store their produce as they sell most of their produce fresh and do not process. Akinwale et al (2001) observed that despite the increase in cashew production in Nigeria, it is only the cashew nuts that are being utilized in the processing industry.

Effect of constraints on cashew farmers' income
The result of the analysis shows that constraints experienced by cashew farmers in the study area negatively affect the income generated from cashew fruits ($r=0.177$, $P=0.051$). This shows that there is a significant relationship between constraints and income generated by farmers. It implies that a significant in constraints will lead to reduction in income of cashew farmers (Table 4).

Conclusion and Recommendation
Cashew production in Orire LGA of Oyo State is male dominated (84.5%) of the farmers are males. The cashew farmers are relatively young with low level of education. There is inadequate capital (finance) that can be used to expand their farm land as 65.5% of the respondents cultivate 0.10 and 5.99ha which is too small for commercially sized farm. Majority of the farmers are using unimproved varieties in their farms as planting materials in the establishment of new farms. Other problems of importance are insufficient price information, high cost of transport, low farm gate price, insufficient

labour, lack of processing industries and lack of good roads.

These problems can be ameliorated by formulating and implementing economic policies aimed at increasing the level of education which could increase their level of receptivity of improved technologies of cashew production. Government should provide soft loans to the cashew farmers to enable them establish cottage industries in order to alleviate the constraints of inadequate capital (finance) and lack of processing industries. There should be a collaborative work between CRIN and ADP to enhance awareness creation and easy access to adequate information such as recommended use of improved varieties by cashew farmers in the study area.

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FIGURES AND TABLES

Table 1: Distribution of respondents by their personal characteristics

Variable	Frequency	Percentage
Age group		
<30years	3	2.70
30-49	58	52.70
>50	49	44.60
Total	**110**	**100.00**
Sex		
Male	93	84.50
Female	17	15.50
Total	**110**	**100.00**
Level of education		
No formal education	53	57.30
Primary	41	28.20
Secondary	11	10.00
Tertiary	5	4.50
Total	**110**	**100.00**

Source: Field survey, 2004

Figure 1: Distribution of respondents farm size
Source: Field survey, 2004

Table 2: **Distribution of respondents based on varieties used for planting**

Varieties	Frequency	Percentage
Local varieties	89	80.90
CRIN improved varieties	10	9.10
Brazilian Jumbo nuts	11	10.00
Total	**110**	**100.00**

Source: Field survey, 2004

Table 3: Ranking of respondents constraints according to their severity

Constraints	Frequency	Percentages	Mean scores	Ranking
Insufficient price information	25	22.70	210	6th
High cost of transport	23	20.90	209	7th
Low farm gate price	30	27.30	225	3rd
Inadequate Extension services	8	7.30	151	10th
Insufficient labour	26	23.60	212	5th
Poor marketing channel	30	27.30	225	3rd
Inadequate market information	20	18.20	185	9th
Poor quality nuts	6	5.50	104	12th
Lack of storage facilities	22	20.00	193	8th
Lack of processing industries	73	66.40	273	2nd
Lack of good access road	28	25.50	217	4th
Insufficient buyers	7	6.40	139	11th
Inadequate capital (Finance)	77	70.00	287	1st

Constraints	Frequency	Percentages	Mean scores	Ranking
Insufficient price information	25	22.70	210	6th
High cost of transport	23	20.90	209	7th
Low farm gate price	30	27.30	225	3rd
Inadequate Extension services	8	7.30	151	10th
Insufficient labour	26	23.60	212	5th
Poor marketing channel	30	27.30	225	3rd
Inadequate market information	20	18.20	185	9th
Poor quality nuts	6	5.50	104	12th
Lack of storage facilities	22	20.00	193	8th
Lack of processing industries	73	66.40	273	2nd
Lack of good access road	28	25.50	217	4th
Insufficient buyers	7	6.40	139	11th
Inadequate capital (Finance)	77	70.00	287	1st

Source**:** Field survey, 2004

Table 4: Correlation between respondents income and constraints

Variables	R	P	Remark
Constraints and income	-0.177	0.051	S

Level of significance 0.05
Source: field survey, 2004

CROP PROCESSING AND UTILISATION PROGRAMME

Experimental Title: Production and evaluation of choco-breakfast cereal meal (Jayeola, C.O.)

Abstract

The high consumption of maize by human population in a number of countries in Latin America and Africa and the well-established lysine and tryptophan deficiency in maize proteins has led to many studies on the fortification of maize with other plant source in order to complement the missing essential proteins in maize.

Choco breakfast flakes were prepared from yellow maize fortified with 1-3% cocoa powder inclusion.

Proximate, physic-chemical and sensory analyses were carried out on the newly formulated products.

The results of the choco product as compared with the control revealed that the product compared favourably with the control a 2% cocoa powder inclusion.

Introduction

Breakfast cereal flakes have received much acceptance and demand above the traditionally consumed cereal gruels and paps such as Ogi in Nigeria. Most of the breakfast cereal flakes produced from Nigeria are produced from maize- a cereal grain that has drink alternative industrial uses. Research had shown that protein malnutrition in Nigeria is as a result of limited sources of protein of high biological value. Particular those from animal origin. Cereals proteins are deficient in some essential amino acids needed for proper nutrition (Enuere 1998). However blending maize and cocoa hat contains some proteins, minerals and antioxidants will boost the nutritional quality of the breakfast meal.

Materials and Methods

Yellow maize (zea mays) were purchased at Oja-oba market. The grains were cleaned to remove stains, extraneous materials and broken kernels. The cleaned maize grains were milled using hammer mill fortification of maize flour with cocoa powder were made at 1-3% level, while salt and sugar were added. The different formulation were mixed in mixer until they became homogenous, these are steamed in a pressure cooker, flaked and toasted. The productions were allowed to cool before packaging.

The physico-chemical analysis and sensory evaluation carried out on the different product using the methods of cruzy et al, 1996 and AOAC 1990. All parameters were compared with commercial corn flakes.

Result

Table 1: Physico chemical characteristics of choco breakfast cereal

Sample	Bulk density (mm)	Thickness (mm)	Oggnets (mm)	Water absorption (g) 1m	3mm	5mm
Choco flakes (1%)	0.53	2	6	1.12	1.38	1.41
Choco flakes (2%)	0.54	2	6	1.24	1.42	1.60
Choco flakes (3%)	0.56	3	8	1.45	1.60	1.73
Control	0.31	1	5	1.10	1.41	1.50

Table 2: Chemical composition of choco breakfast 2(%) and control

Sample	Moisture	Protein	Fat	Fibre	Ash	CHO
Choco breakfast (%)	9.22	18.35	9.10	8.2	3.1	56.63
Control	9.16	12.12	9.40	11.1	3.2	58.2

Discussion

Result of sensory evaluation showed that choco breakfast flake was acceptable at 2% inclusion of cocoa powder. Table 1 shows some physico-chemical attributes of the products while table 2 showed the proximate composition of the accepted product as compared with the control. The result of the microbiological analysis of the different product does not indicate the presence of microbes that are of public health importance.

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Cruzy Celis L.P Ronney L.W. and Mc Donough C.M. (1996): A ready to eat breakfast.

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Experimental Title: Production methods of protein concentrate and isolate from cashew (anacardium occidentale L.) nut. (Ogunwolu S.O.)

Introduction

Cashew kernel is of high food value with about 40-57% oil, and 21% protein contents (Fetuga, et al,175). It is an important delicacy, which is mainly used in confectionery and as dessert nut. The kernel can be roasted and consumed; it can also be used as adjunct in chocolate and chicken feeds (Kapur et al, 1952). The powdered milk used in standard milk chocolate recipe was replaced with 25% roasted cashew kernel (Ogunwolu and Akinwale, 2003).

Protein utilized in food processing are of various origins, and can be roughly grouped into animal protein (e.g. gelatin), vegetable proteins (e.g. Soya protein), and animal derivatives protein (e.g. milk proteins) (penny 199). Proteins that are essential to growth and health are currently required more in the developing countries of the world, because of prevalent outbreak of protein-energy malnutrition in these countries. Shortages plus high prices have recently caused restriction of animal proteins in the diets of many families in the developing countries of the world (Penny, 1999). However, vegetable proteins which are cheaper and available are of great potentials as a direct food for human consumption. Many of the vegetable proteins require processing to provide a food material having acceptable organoleptic properties for human consumption.

In view of increasing production of cashew globally, there is need for increased utilization of cashew nut, especially the nutritious cashew kernel, Cashew kernels are therefore being considered and an additional source of protein concentrate and isolate for use in human food products.

The objectives of this work therefore are to determine the appropriate production methods for the production of protein concentrates and isolates from cashew nut and to determine the protein content and protein yield of the concentrates and isolates.

Materials and methods:

Cashew nuts were obtained from the cashew plots of Cocoa Research Institute of Nigeria, Ibadan, Nigeria. Chemicals and equipments used were as in the Applied Biochemistry group of Institute for plant genetics and crop plant research, Gatersleben, Germany.

Defatted Cashew nut Powder Production

Cashew kernels were ground using pestle and mortal. The flakes were then extracted with n-hexane two times using a flake to solvent ratio of 1:10(w/v) with continuous magnetic stirring (1-kamag reo magnetic stirrer model-by Drehzahl Electronics) for 1 hour.

Extraction of cashew nut proteins

Method 1: Alkaline extraction-isoelectric precipitation method (IP): The methods of Wagner, (2000) were used; the defatted cashew nut flour was extracted at room temperature (about 20^{o}C) by using two different cashew nut powder to water ratios of 1:5, and 1:10. The distilled water used was also adjusted to two different pH of 7.0 and 9.0, using 0.1N NaOH. The suspension was stirred using magnetic stirrer for 1hr, and then cold-centrifuged (using Heraues Multifuge 1 S-R) at 1000 x G for 30mins, at 4^{o}C. The supernatants were mixed together, divided into two and adjusted to two different pH of 3.5 and 4.5 by addition of 0.1N HCI, allowed to stay for 2hrs at 4^{o}C, and then centrifuged again for

30mins at 4°C and 1000 x G. The supernatants were poured off to obtain cashew protein slurry which was at the bottom of the flask. The cashew protein slurry was freeze-dried in CHRIST Freeze-Drying system (Martins Christ, Germany, model; Alpha 2-4) for 12hrs. The cashew proteins were then ground in a laboratory mill so as to pass through a 103-mesh screen and then packaged. The proteins were stored at –10°C.

Method 11: Alkaline extraction-Methanol precipitation method (MP): The defatted cashew nut flour was extracted at room temperature (about 20°C) by using two different cashew nut powders to water ratios of 1:5, and 1:10. The distilled water used was also adjusted to two different pH of 7.0 and 9.0, using 0.1N NaOH. The suspension was stirred using magnetic stirrer for 1hr. Insoluble material was separated from the filtrate by filtration using Vacuum filter. The filtrates were mixed together, divided into two and mixed with different Methanol concentrations of 70 and 80%, allowed to stay for 2hrs at 4°C and then cold-centrifuged (using Heraeus Multifuge 1 S-R) at 1000 x G for 30mins. The supernatants were poured off to obtain cashew protein slurry which was at the bottom of the flask. The alcohol was removed from the cashew nut protein fractions slurry using Vacuum desolventiser (Hanson (1974). The cashew nut protein fraction slurry was freeze-dried in CHRIST Freeze-Drying system (Martins Christ, Germany, model; Alpha 2-4) for 12hrs. The cashew nut protein fractions were then ground in a laboratory mill so as to pass through a 103-mesh screen and then packaged. The protein fractions were stored at-10°C. All reported values are average of triplicate experiments.

Protein content determination: The protein content of the cashew meal and sixteen cashew nut protein fractions produced as described above were carried out using 2-D Quant Kit method (Amersham Biosciences, 2003).

Results and Discussion

Table 1 and 2 showed the effects of extraction ratio, extraction pH, precipitation pH, and Methanol precipitation concentrations on the protein yield and protein contents of cashew nut protein fractions produced by alkaline extraction-isoelectric precipitation (IP) and alkaline extraction-methanol precipitation methods

Table 1: Protein yield and content of cashew nut protein fractions produced by Alkaline Extraction – Isoelectric Precipitation (IP) Method.

	Ext. Ratio	Exdt. pH	Ppt pH	Protein Yield(%)	Protein Content(%)
CNPIP1	1:5	7.0	3.5	57.83 ± 2.06^{f}	44.40 ± 0.10^{h}
CNPIP2	1:5	7.0	4.5	60.60 ± 0.30^{g}	63.06 ± 0.95^{g}
CNPIP3	1:5	9.0	3.5	69.30 ± 0.30^{d}	68.10 ± 0.20^{c}
CNPIP4	1:5	9.0	4.5	79.50 ± 0.50^{c}	78.16 ± 0.35^{b}
CNPIP5	1:10	7.0	3.5	48.20 ± 0.35^{g}	50.80 ± 0.30^{g}
CNPIP6	1:10	7.0	4.5	59.10 ± 0.10^{f}	61.43 ± 0.25^{f}
CNPIP7	1:10	9.0	3.5	90.60 ± 0.10^{b}	$66/60 \pm 0.40^{d}$
CNPIP8	1:10	9.0	4.5	98.90 ± 0.00^{a}	99.80 ± 0.10^{a}

NOTES:
Mean ± standard deviation of three replicate determinations.
CNPIP: Cashew nut protein-isoelectric precipitated.
EXT: Extraction
PpT: Precipitation.

The highest protein yield (89.9%) was obtained from CNPIP 8 method with extraction ratio 1:10, extraction pH 9.0, and precipitation pH 4.5. This confirmed Damodaran (1997) findings that, most proteins are highly soluble at alkaline pH (7-9) and that protein extraction from plant sources are best carried out at this pH, and the protein then recovered from the extract by isoelectric precipitation at pH 4.5 – 4.8. This was followed by CNPIP 4 method with 1:5 extraction ratio, 9.0 extraction pH, and 4.5 precipitation pH that gave 90.6% protein yield. The lowest protein yield (44.4%) was obtained from CNPIP 1 with extraction ratio 1:5, extraction pH 7.0, and precipitation pH 3.5. From these results it could be deduced that, extraction pH 9.0 and precipitation pH 4.5 are the most suitable conditions for the production of cashew nut

protein isolates by IP method as they gave the first and second highest protein content out of the eight IP methods used. Protein yield is an important factor in the commercial production of the vegetable protein isolates as it gives an indication of the efficiency of the method used, which will result in to quantity of the final products. Protein yield of the protein isolates produced CNPIP 2,3,4,5,7 and 8 were significantly different from each other, while the protein content of protein isolate produced by CNPIP 1 and CNPIP 6 were significantly different from one another, and are significantly from others at 5% probability level. However, according to CODEX STAN 174 (1989), out of all IP methods, cashew nut protein isolate was produced fron CNPIP 8 only, which gave 99.8% protein content; this is similar to what was obtained fro pea nut protein isolate (Manak et al, 1980)

Table 2: Protein yield and content of cashew nut proteins fractions produced by Alkaline Extraction – methanol Precipitation (MP) Methods**.**

	Ext. Ratio	Exdt. pH	Ppt pH	Protein Yield(%)	Protein Content(%)
CNPMP1	1:5	7.0	70.0	55.33 ± 0.15^{f}	70.30 ± 0.20^{de}
CNPMP2	1:5	9.0	70.0	57.90 ± 0.20^{e}	72.30 ± 0.10^{cd}
CNPMP3	1:10	7.0	70.0	59.33 ± 1.16^{d}	85.70 ± 0.10^{b}
CNPMP4	1:10	9.0	70.0	88.20 ± 0.10^{a}	89.20 ± 0.10^{a}
CNPMP5	1:5	7.0	80.0	58.53 ± 0.06^{e}	68.20 ± 0.20^{e}
CNPMP6	1:5	9.0	80.0	61.70 ± 0.10^{c}	64.00 ± 0.10^{f}
CNPMP7	1:10	7.0	80.0	52.10 ± 0.17^{g}	72.40 ± 0.10^{cd}
CNPMP8	1:10	9.0	80.0	63.10 ± 0.17^{b}	74.56 ± 3.86^{cd}

NOTES:
Mean ± standard deviation of three replicate determinations.
CNPMP: Cashew nut protein-methanol precipitated.
EXT: Extraction
Meth conc: Methanol concentration

The highest protein yield (88.2%) was obtained from CNPMP 4 method with extraction ratio of 1:10, extraction pH 9.0, and precipitation methanol concentration of 70%. While the least protein yields (52.1%) was obtained from CNPMP7 method with extraction ratio of 1:10, extraction pH 7.0, and methanol concentration 80%. The highest protein content (89.2%) was obtained from the same CNPMP 4 method that gave the highest protein yield. This confirmed the results from the IP methods that extraction of protein from cashew nut. 70% methanol concentration is the most suitable for the production of cashew nut protein; this is in line with the results obtained by Adebowale (2005) on the production of Mucuna bean protein isolates precipitated using ethanol. According to CODEX STAN 174 (1980), MP method was not suitable for the production of cashew nut protein isolates, as the protein content obtained from this method were less than 90%. However, all MP methods except CNPMP 6 were suitable for the production of cashew nut protein concentrates, since heir protein content are within 65% and 90%.

Conclusion

Protein concentrates and isolates of commercial quantity could be produced from cashew nut. Generally, extraction ratio of 1:10, and extraction pH of 9.0 and isoelectric precipitation of 4.5 are suitable for the preparation of cashew nut protein concentrates and isolates using Alkaline extraction, isoelectric precipitation method. Also, using Alkaline-extraction, methanol-precipitation method, extraction ratio of 1:10, extraction pH of 9.0 and precipitation methanol concentration of 70% are most suitable for the preparation of cashew nut protein concentrates.

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Experimental Title: Chemical compositions of dry processed green robusta (*Coffee canephora*) coffee (Ogunjobi M.A.K. and Ogunwolu S.O.)

Introduction

Coffee belongs to the family Rubiaceae, which has some 500 general and over 6000 species[2]. The two most important commercial species cultivated in Nigeria are the highland coffee (Arabicacoffee) which account for only 4% and the lowland coffee (robusta coffee) which accounts for about 94% of coffee export [7,8]. Though Arabica coffee is of the greatest economic importance in the international market, but robusta coffee contains about 40-50 percent more caffeine than Arabica. For the reason, it is used as an inexpensive substitute for Arabica in many commercial coffee blends.

Good quality robusta are used in some espresso blends to provide a better foam head and to lower theIngredient cost[6].

Coffee passes through various stages of primary processing in the country of production before it is exported as unroasted “green coffee” and this can be done in two ways, known as the dry (natural)and the wet (washed) methods. Green coffees from different countries or regions usually have distinctive characteristics such as flavor, aroma, body and acidity[5]. These taste characteristics are dependent not only on the coffee’s growing region, but also on genetic subspecies (varietals) and processing method. The price paid for coffee depends on coffee varieties (Arabica/robusta), the processing conditions (dry/wet) and the altitude where coffee is grown[2,3].

It has been reported by some researchers that all the green coffee produced in Nigeria are dry processed and that the quality is very poor and some of them even recommended wet processing method to enhance the beans quality. However, there was no literature on the chemical composition of the green coffee produced through dry process and such information is the basis for the premium payment in the international market. Hence, this work reported on the chemical compositions of dry processed green coffee in Ibadan.

Materials and Methods

The experiment was carried out at CRIN Headquarters, Ibadan. Five robusta clones (C36, C90, C111, T1049, M10) selected by CRIN for their genetic diversity and high yielding were harvested from the coffee plantation of the Institute. The standard dry processing method described by Clarke and Macrae (1987) was adopted for the production of green coffee. The moisture, caffeine, fats, proteins, carbohydrates, trigonelline, chlorigenic acids, organic acids, ash, pH and acidity were determined according to AOAC methods (1990).

Results and Discussion

Table 1: chemical Composition of Dry Processed Robusta

CLONES	C36	C90	C111	T1049	M10	AVERAGE
Moisture (%)	12.58	12.34	12.71	12.62	11.95	12.44
Caffeine (%)	2.94	3.02	3.11	2.98	3.20	3.05
Fats (%)	10.88	10.92	11.12	10.90	10.22	10.81
Proteins (%)	12.30	12.38	11.95	12.20	11.89	12.14
Carbohydrates (%)	48.20	48.32	47.93	48.28	48.30	48.21
Trigonelline (%)	0.60	0.61	0.63	0.60	0.61	0.61
Chlorogenic acids (%)	8.32	8.14	8.28	8.30	8.20	8.25
Organic acid (%)	1.62	1.48	1.53	1.72	1.40	1.55
Ash (%)	4.32	4.38	4.37	4.35	4.38	4.36
pH	6.05	6.10	6.04	6.05	6.04	6.06
Acidity from 6 to 8 (Meg/Kg)	84.3	86.4	85.4	87.1	89.2	86.5

Table 1 showed the chemical composition of dry processed robusta from the five clones investigated. There were no any significant differences in all the parameters evaluated among the five clones. The results obtained from these experiments were within the range of the chemical compositions for green robusta coffee as reported in some literatures. This suggests that all the clones can be harvested together and then treated as robusta coffee. The results also showed that if the procedures for the standard dry process method are strictly followed, good quality green coffee of international standard can be obtained.

Conclusion

Chemical compositions is one of the parameters used in determining the price paid for green coffee and this study showed that if coffee cherries are properly and carefully dry processed, good quality beans can be obtained. However, since it has been reported that wet processed coffee produced better quality beans, it will be necessary to carryout put further experiment to establish this fact.

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Experimental Title: Production and chemical properties of cashew (a*nacardium occidentale,* L.) apple powder (Ogunwolu S.O. and. Ogunjobi M.A.K.)

Introduction

Cashew apple is a climacteric fruit, thus exhibits a pronounced increase in respiration coincident with the on-set of ripening, which resulted in to very short storage life. Cashew apple therefore must be used within 24hours of harvest (Ohler, 1979). It is therefore pertinent to adopt an economical and technical method of cashew apple preservation and processing to reduce its high post-harvest losses and non-availability during the off-season period. The objectives of this work was to increase the utilization of cashew apple through the establishment of the processing method of cashew apple powder as well as determination of physical and chemical properties of the powder.

Materials and Methods

Cashew apple powder production: Fresh cashew apples were obtained from the plots of CRIN, Ibadan. Matured ripe cashew apples were selected, washed, and the nuts removed. One batch of the apples was sliced, while another batch was diced. Both batches were dried in the electric oven at 30^{o}C for 12hours, and in the sun (about 29^{o}C), until it was fully dried. In the other trials, juice was extracted from the cashew apples before it was dried in the oven and sun as above. All samples were ground into powder, and stored in air-tight containers.

Chemical analysis: Moisture content, Vitamin C, Ash content, Crude protein, Fat, Crude Fibre and Carbohydrate, were determined according to AOAC (1990) methods.

Result and discussions

From the six methods used for the production of cashew apple powder, Diced-whole fruit and sun dried sample was the best in terms of colour and flavor retention (subjectively observed). This may be as a result of gradual drying in the sun. The moisture content of the oven-dried samples (Table 1) were higher than that of sun-dried samples, and significantly different ($p<0.05$) from each other, this may be as a result of high drying rate in oven which may cause case hardening and thus inadequate drying. Vitamin C content of the sun-dried samples was also higher than that of oven-dried samples (Table 1). According to Akinwale and Aladesua, (1995), high temperature and long period of application was found to destroy Vitamin C in cashew juice. Also, the Vitamin C, Ash and carbohydrate contents of the extracted samples were lower than the whole samples, and they were significantly different ($p<0.05$) from each other. This bmay be as a result of the extraction of the juice. There were no significant difference ($P>0.05$) in the crude fibre of all the samples.

Conclusion

Cashew apple powder of good physical and chemical properties could be produced from diced-whole fruit, and sun-dried. The cashew apple powder could therefore be an additional source of food ingredients.

The determination of the functional properties of these cashew apple powders is on-going.

Table 1: Chemical composition of cashew apple powders.

	DWS	SWS	ES	DWO	SWO	EO
Moisture content (%)	8.50b	7.85c	7.25c	10.65a	9.70a	8.08b
Vitamin C (mg/100g)	180.00a	160.00b	110.00d	152.00c	148.00c	100.00d
Ash (%)	1.95a	1.90a	1.70b	1.85a	1.75b	1.70b
Crude fibre (%)	2.30a	2.10a	2.20a	2.20a	2.10a	2.30a
Carbohydrate (%)	29.00a	28.00a	24.00b	28.00a	29.00a	23.00b

NOTES:

Means followed by the same alphabetic on the column are not significantly different at $p>0.05$.

DWS - Diced, Whole, Sun-dried
SWS - Sliced Whole, Sun-dried
ES - Extracted, Sun-dried
DWO -Diced, Whole, Oven-dried
SWO - Sliced, Whole, Oven-dried
EO - Extracted, Oven-dried

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Experimental Title: Adsorption of heavy metals on the pod husk of theobroma cacao (Ajao, A.A.)

Introduction

Most water bodies in Nigeria have constantly been polluted with heavy metals; this is largely due to industrialization. The removal of heavy metals from waste waters in economic fashion still remain an important problem as much have been spent by industrialist and other stakeholders to get their waste waters treated before discharge into water bodies. Widely used methods are the ion exchange methods which are rather expensive and uneconomical. In the continuous search for alternate systems for water effluent treatments for heavy metals ions, cocoa pod husk obtained from the plant theobroma cacao, a seemingly agricultural waste stands possible utilization. This study was therefore to exploit CPH as an adsorbent for heavy metal ions.

Materials and methods

Equilibrium sorption of aqueous ions of cadmium, lead and zinc on cocoa pod husk was carried out using various concentrations. In a typical experiment, 1g of CPH was dispersed in $0.1dm^3$ of an aqueous solution of metal ions of known concentration. The mixture was continuously shaked in a well stoppered flask over a range of contact time. The mixture was filtered at the end of each contact time and the residual concentration of the metal ion in the filtrate was determined using the flame Atomic absorption spectrophotometer in accordance with IUPAC standard.

Results and discussion

The variation of the amount of metal ions sorbed from solution by CPH with initial metal ion concentration is shown in Table 1. The results indicated that relatively high amount of metal ions are removed from solution by CPH. The amount of Cd ions that were removed were higher than those of Pb and Zn ions.

Table 1. Equilibrium sorption of heavy metals on Cocoa Pod Husk

Initial metal ion (mg/l)	Equilibrium metal ion (mg)	Amount of metal ion Sorbed (mg/g)
Pb (11) 100	23.7	76.3
200	70.6	129.4
300	114.6	185.4
400	228.4	171.6
Cd (11) 100	1.9	98.1
200	11.4	188.6
300	21.1	276.9
400	45.6	354.4
Zn (11) 100	20.4	79.6
200	51.0	149.0
300	96.3	203.7
400	152.0	248.0

Table 2: Distribution coefficient, D of metals ions

Metal ion	CE (mg/1)	D
Pb(11)	23.7-228.4	0.75-3.22
Cd(11)	1.9-45.6	7.7-51.6
Zn (11)	204-152	1.63-3.9

Values in table 2 shows the distribution coefficient for the range of metal ions concentrations. The results indicated that the concentration of the metal ions at the sorbent-water interface is higher than the concentration in the continuous aqueous phase, thus suggesting that CPH is relatively effective in removing metal ions from aqueous waste waters.

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Experimental Title: Effect of temperature on lipase enzyme activities from organisms isolated in stored cashew nut oil (Igbinadolor, R.O.)

Introduction

Cashew kernel oil is a good source of vegetable oil which has been recognized and thus has found great use in domestics cooking, pharmaceuticals and in industries for the production of soap and margarine (Ojeh, 1985). The cashew nut consists of an outer shell epicarp, which is greenish to pinkish brown colour depending on its degree of dryness. Within the outer shell, there is a honey combed structure (mesocarp) in the cells of which is secreted a natural resin, known commercially as cashew nut shell liquid (CNSL).

Today the crop is extensively cultivated for its nuts, which could be roasted, packaged and marketed or processed into vegetable oil (cashew nut kernel oil). (Adebayo and Diyaolu, 2003). Unfortunately, cashew kernel from which the oil is extracted is very susceptible to deterioration and spoilage. This is due to microbial attack as a result of improper storage. Cashew nut kernel is hygroscopic by its nature and if the critical water content of stored cashew kernel is exceeded due to poor storage, it promotes hydrolytic/enzymatic fat cleavage by the lipase enzymes produced by the infecting microbes. All earlier investigations were concentrated on the mycology of this study is therefore aimed at studying the deterioration of cashew nut kernel under storage, and the characterization of the lipolytic activities in the microbial isolates in vivo.

Materials and methods

Good grade cashew nut of the current season was obtained from the storage unit Cocoa Research Institute of Nigeria. The nuts were carefully selected to ensure that infected ones were not infected.

The cashew kernel was isolated using a simple cutter knife. This was used to slit each nut open and pointed knife employed to remove the kernel

immediately from the shell to minimize contamination with the cashew nut shell liquid (CNSL). The kernel was then subjected to roasting at 80°C for one hour to remove the testa. Four storage conditions were chosen for investigation and organisms isolated were identified using microscopic, biochemical and physiological characteristics and by reference to identification manuals.

Screening for Lipase Production from the Isolates and enzyme assay: Two frequently occurring fungal isolates – *Aspergillus niger and Rhizopus sp.* Were grown in a chemically – defined medium for enzyme production using the methjod of (Ballageon et al. 1989). Lipolytic activity of the enzymes obtained from both bacteria and fungi was determined using the modified method of *Parry et al., (1996)* at different temperature ranges of 4, 10, 30, 37 and 45°C.

Result and discussion

Four microbial isolates were frequently encountered. Based on the frequency of occurrence of the isolates two fungi and two bacteria were screened for lipolytic activity. Table 1 indicates lipolytic activity of the four microbial isolates (*B. subtilis, B. licheniformis, Rhizopus sp and A. niger)* in both system, *A niger* produced the highest free fatty acid followed by *Rhizopus sp., B. subtillis and B. licheniformis* respectively. *A. niger,* the highest producer was then chosen for further studies.

Table 1: Lipolytic Activity of Isolates after 1hour of Incubation

Isolates	Lipolytic activity (units/ml)
Bacillus subtilis	0.1417
Bacillus lincheniformis	0.1333
Rhizopus sp.	0.1917
Aspergillus niger	0.2083

Considering temperature as a parameter for lipolytic activity, the highest enzyme activities observed in *A. niger* lipase was at 37°C. This result is in conformity with the findings of Chander et al., (1977). Above this temperature, there was a marked decrease in lipolytic activity showing the enzymes to be very sensitive to high temperature, which could lead to denaturation. Most reports including this one show that lipase activity of *Aspergillus niger* is greatest at 37°C, since cashew kernel is normally stored at room temperature, the lipase activity of most lipolytic organisms like *A. niger* could be enhanced if not stored at the suitable relative humidity because lipase enzyme hydrolyses esters in oil preferentially at the interface between lipid and water in heterogeneous system.

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Experimental Title: Variation in the physicochemical characteristics of cashew (*Anacardium Occidentale L.*) apples with maturity (Yahaya, L.E.)

Introduction

The origin of cashew can be traced back to the Northern part of South America. Its natural distribution is somewhat obscure because of its long and initial association with man. The tree has a long and colourful history as a valuable plant. The cashew tree consists essentially of the nuts, an embryo shaped shell and false fruit cashew apple. The kernels when roasted have that pleasant flavor and taste. The kernel is the main product of cashew industry especially in Nigeria and to avoid contamination with the cashew nut shell liquid, it must be extracted whole. To maximally harness the quality attribute of these different cultivars based on apple colour, their physical and chemical assay need to be investigated at each developmental stage, hence, the study reports the changes in the physicochemical profile of the red and yellow apple cultivars of cashew.

Materials and method

Cashew apples used for this study were collected from Cashew research plot of the Cocoa Research Institute of Nigeria, Ibadan. Developing cashew apples at different stages of development (3 – 9 weeks after pollination (WAPo) were harvested weekly for physicochemical assay. The juice from each sample collected was expressed mechanically. The pH of apple juice samples were determined according to AOAC (1990) using the Kent EIL7020 model pH meter. The specific gravity was carried out using a pycnometer while the refractive index was measured using the Abbe refractometer according to AOAC (1990), the chlorophyll content of the samples was measured by determining the magnesium ions being the precursor of chlorophyll using complexiometric titration. The ascorbic acid concentration was determined using the indo-phenol method as described by AOAC, 1990. The astringency was measured by determining the concentration of tannin using spectrophotometer (AOAC, 1990). Tannic acid was used as the standard, while absorbance was read at 660nm.

Results and discussion

Table 1: Changes in the physical and chemical characteristics of the red cashew apple with maturity

WAPo	% Juice	pH	RI	SG
1-2	ND	ND	ND	ND
3	6-4	3.73	1.68	1.001
4	7.3	3.84	1.74	1.001
5	14.9	3.96	1.83	1.003
6	43.7	4.09	1.88	1.003
7	63.1	4.45	1.89	1.004
8	69.8	4.48	1.89	1.007
9	74.1	4.51	1.89	1.007

ND: Not determined; RI: Refractive index; SG: Specific gravity

Table 2: Changes in the physical and chemical characteristics of the yellow cashew apple with maturity

WAPo	% Juice	pH	RI	SG
1-2	ND	ND	ND	ND
3	9.1	3.64	1.34	0.991
4	9.9	3.81	1.37	0.994
5	18.6	3.99	1.53	1.002
6	49.4	4.03	158	1.004
7	67.2	4.40	1.61	1.005
8	71.1	4.42	1.83	1.005
9	79.5	4.55	1.83	1.009

ND: Not determined; RI: Refractive index; SG: Specific gravity

The physical and chemical characteristics of the red and yellow cultivars of cashew apple are shown in Tables 1 and 2 respectively. Within the first two weeks after pollination, samples were too small. At this stage, the developing apples is still at the receptacular stage and rarely contain any significant assimilates. The volume of juice produced is linearly related to the age and stages of maturity of the apples. However, the yellow apple showed higher juice content at the end of the 9th WAPo. This trend is in line with other

climateric fruits, like citrus that have been reported with increase from 3rd to the 9th WAPo for both apple colours, but with a sharp increase between 6 and 7 WAPo. This is an indication that the acidity level decreases from the 3rd to 9th WAPo. This trend can be explained on the basis that Pectin-methyl esterase which decreases as a result of the ripening process and this consequently reduces the sharpness characteristics of the unripe fruit (Nicolini et al, 2000). The observations of between 6 and 7 WAPo in pH is an indication of biochemical changes, at the period. Aliyu and Hammed, (2000) discovered a similar occurrence at same period and they attributed the observation to physiological changes in the growth and development of cashew apple.

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Experimental Title: Insect pests encountered in a cashew plantation in Ibadan, Nigeria

(Mokwunye, I.U., J.C. Anikwe and F.A.Okelana)

Introduction:

The cashew plant, *Anacardium occidentale* (Anacardiaceae) is a perennial crop that is cultivated in the tropical humid climate (Akinwale and Esan, 1989). It was intoduced into Nigeria by Portuguese traders around the 15th/16th century (Ohler, 1988). Its cultivation was also considered essential for tree cover in eroded areas where land reclamation programmes were under way to prevent further erosion (Dwomoh *et al.,* 2008). Cashew is potentially a great socio-economic crop to Nigeria.

A myriad of insect pests have been found to attack cashew like many other tree crops. However, very few are observed to cause economic damage in Nigeria. These include the longhorn beetle-*Analeptes trifasciata* Fabricius (Coleoptera: Cerambycidae) which girdles stems and branches , the red-banded thrips-*Selenothrips rubrocinctus* Giard (Thysanoptera: Thripidae) which attack the leaves and the fruit scrapper- *Pachnoda cordata* Drury (Coleoptera : Scarabaeidae) in descending order of importance (Adeyemo and Okelana, 1989). A lot of these insect pests associated with cashew are yet to be identified as well as their damage potential which is yet to be estimated. Adeyemo and Okelana (1989) reported that the three major insect pest of cashew were *Analeptes trifasciata, Selenothrips rubrocinctus and Pachnoda cordata*. In 2006, the cashew leaf miner , *Acrocercops syngramma* was reported as having reached a major pest status while in 2008, the incidence of cashew stem borer,*Plocaederus ferrugineus* as an emerging major cashew pest and its management has been reported (Anikwe *et al.,* 2008 (In press). The alarming rate of dieback of cashew seedling at CRIN nursery coupled with various unidentified damage characteristics found on well established cashew stands in the plantations which include twig dieback which has been found to be caused

by *Helopeltis* spp as reported by Mokwunye (2008 (personal comm.), sudden death of trees, fruit and flower shedding, snapping of trunks and branches and boring of branches have all been observed. These observations which are different from the ones earlier reported necessitated this study. In view of the above, observation of the insect pests of cashew and their damage will help in further reclassification of their pest status and this will give us a formidable background information needed for the development of sustainable management strategy that is ecologically sound.

Materials and methods:

The study was conducted on a 1ha cashew plantation located at the CRIN Head quarter in Ibadan. The cashew plantation was established in 2005 and planted in geometry of 6m by 6 m with a total of 320 stands. Ibadan has an annual rainfall average of 2000mm with a bimodal pattern. CRIN is located in the humid rainforest ecosystem with mean solar radiation of 18mj/m^2/day. It lies between the latitude 7º30'Nand longitude 3º 54'E at an altitude of 200m above sea level.

Twenty mature trees were randomly sampled on a fortnightly basis from the base to girth at breast height of 1.5m for insect pests. Insects were collected from the stem, branches, twigs, underneath the leaves, fruits (young and mature apples and nuts), and inflorescences. Flying insects were collected by means of sweep nets. Various insects collected from the trunks, branches, leaves were carefully brushed with a camel brush into a 2Ib kilner jar embedded with cotton wool soaked with ethyl acetate. All developmental stages of insects (eggs, larvae, nymphs, pupae and adults) were recorded. Panicles and fruits (apples and nuts) were considered damaged when there are symptoms of brownish and watery lesions, necrotic lesions, dieback and fruit deformation with scars. In another occasion, symptoms were later confirmed in the laboratory when live and yet – to-be identified insects were taken to the laboratory, reared and provided with various parts of the plants as food source to establish which pest was causing which specific damage. Insects knocked off in ethyl acetate were later identified at the Insect collection Centre of CRIN, Ibadan.

Climatic data such as temperature, relative humidity and rainfall were obtained from daily and weekly from meteorological data collected from the meteorological station of CRIN located 1km from the experimental site. Monthly mean separation of data collected on the insect fauna of cashew was done using the Genstat Edition 3.

Results and Discussion

Several species of insect pests were identified on cashew while some were widely distributed others were occasionally found. Most of the insect pests damaged the crop by sucking sap, branch girdling, stem boring, defoliation and boring.The incidence of most insect pest recorded during the period of survey was higher at the onset and during of the rainy season, this can be attributed to the abundance of food source and breeding sites due to the favourable climatic condion.

The major apple feeders observed were *Smaragdesthes guerini, S. Africanus, Gametis sanguinolenta, Pseudotheraptus devastatus* and *Pachnoda cordata* Drurry (Coleoptera: Cetoniidae). Prominent among the pseudo-apple feeders was *Pachnoda cordata.* They were usually abundant between April and May feeding on young fruits and nuts, thereby predisposing them to secondary infestation by *Drosophilia spp.* and rot organisms. It was not uncommon to encounter fresh termite infestation and grasshopper especially during the dry season.

The predominant species were *Analeptes trifaciata* F., *Helopeltis spp., Acrocercops synagramma,* Meyrick, *Sylepta derogator* and *Parapoderus spp*. The most devastating species belonged to the order Coleoptera which includes the stem girdler, *Analeptes trifasciata* F. (Coleoptera: Cerambycidae) and the stem and

root borer, *Plocaederus ferrugineus* L. (Coleoptera: Lamiidae). The stem girdler, *A. trifasciata* was prevalent during the dry season attaining a mean peak population of 31.0 in November, 2006. This coincided with the period of low rainfall distribution (2.6mm) and relative humidity (65.5%). This agrees with the works of Igboekwe (1983), who observed that the activities of the beetle were predominant between October and December. Topper et.al., (2001) reported that the insect is a major problem on cashew farms in some West African Countries including Nigeria. It was the most common and destructive beetle. They were usually observed girdling the branches to provide suitable breeding site for the larvae in form of dead wood.

The stem and root borer, *P. ferrugineus* was comparatively low with an uneven pattern of distribution. It attained the highest mean population value of 3.0 in May, 2006. It was often characterised by the presence of frass (mixture of wood shavings and gum from the cashew tree) exuding from the tree due to the larvae feeding activities at the base of the tree. Main symptoms of attack are yellowing of leaves, drying of twigs, presence of holes at the base of stem with exuding sap and frass followed by death within weeks. Anikwe *et al.*, (2008) reported the incidence of this previously unknown insect pest in Ibadan. Its occurrence was observed to be isolated and uncommon.

Prominent among the sap sucking insect pests was *Helopeltis* which was prevalent throughout the period of survey with mean peak population of 24.6, 19 and 43.3 in June 2006, July 2007 and June 2008 respectively. This corresponded to the period of high rainfall distribution pattern and high relative humidity as well. According to AIC (2002), the population of *Helopeltis* builds up during the rainy season, as observed in this study. They appear to undergo several generations per year and are thus present in cashew plantation throughout the year under favourable conditions. Topper *et al., (*2001) recorded the presence of *Helopeltis* in some parts of Nigeria though in low population at the period of survey.

Several species of *Helopeltis* have been recorded on a vast number of plants in the Tropical , Oriental and Australian regions (Xianli and Van Der Geest, 1990; Stonedahl, 1991, Peng *et al.*, 1995 and Dwomoh *et al.,* 2008). In Nigeria, *H. bergrothi* has been reported to attack cocoa pods even though it is present in low population. In Ghana, two species *H. bergrothi* on cocoa and *H. schoutedeni* on cashew were reported by Forsyth (1966), Boakye (1995) and Dwomoh (2008). This finding confirms that *Helopeltis* is a common pest of cashew growing communities of the world.

Helopeltis nymphs and adults suck leaves, young shoots, inflorescences, even young apples and nuts (Ranaweera, 2000). Field observation confirmed that fresh damage symptoms mostly occurred on young leaves, tender stems and tender flower stems.. Severe attack of shoot may cause dieback due to bug saliva in combination with fungi infection (Ohler, 1988; TAS, 2000, AIC, 2002). It is known that disease infections can reduce the vigour of plants and enhance their susceptibility to termite attack. In the order Hemiptera, minor insects observed were *Anoplocnemis curvipes* F., *Pseudotheraptus devastans* Dist., *Homoecerus pallens* F., *Aspavia armigera* F., *Atelocera spinulosa and Dysdercus superstitiosus*. However, they were not significant in terms of damage and occurrence.

Fresh symptoms of *Acrocercops syngramma* Meyrick, commonly known as the cashew leaf miner was observed throughout the period of investigation especially between the months of June and September. The highest mean population value of 30.6 was observed in June 2008. The symptoms of infestation, i.e mined portions on leaves were mainly dominant during the wet season when there is abundance of new flushes and this is in line with earlier works. Adeyemo and Okelana, (1989) reported that they

usually appear during the period of new flushes. It was also observed that attack is more severe on young plants. It is increasingly becoming an insect pest of economic importance in cashew plantation; this corroborates the findings of Okelana and Anikwe (2006) who reported the emergence of *A. syngramma* as a major pest on cashew.

Damage is caused by their larvae which destroy the adaxial and abaxial surfaces of young leaves by making serpentine tunnels called mines. Though, the leaf miner does not directly attack the fruit, but the reduction of the leaf photosynthetic area may adversely affect the physiological functioning of the plant depending on the severity. Other defoliators such as *Parapoderus spp*, *Lema tibialis*, and *Zonocerus variegatus* were often observed feeding on leaves. *Parapoderus* spp usually scrapped the epidermis of the leaves.The feeding signs of is characterised by small circular holes on leaves which will dry up and fall. The symptom of infestation of *Sylepta* spp and *Euprotis fasciata* is the presence of rolled leaves by their larvae. They usually attack young tender leaves which eventually dry up and fall.

Conclusion

The survey identified a few beneficial insects species on cashew. They include preying mantids and various ant species.

This study has shown the relative importance of observed insect pests and also provided a baseline information on the ecology of insect pests attacking cashew in Nigeria and this is critical to the development of sound and sustainable control options. Rainfall and humidity strongly interacted with other parameters to determine the population of these observed insect pests. In most of tropical regions, rainfall and relative humidity are the major factors influencing the development of insect population, far exceeding the influence of temperature (Elkinton, 1993; Babib *et al*., 2007).

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FIGURES AND TABLES

Table 1: Insect species associated with cashew, their seasonal abundance and damage characteristics in Ibadan, Nigeria.

Insects Order/family/genus/species	Period of abundance	Parts attacked and Damage characteristics
Parapoderus spp (Coleoptera: Curculionidae)	April-June	Found on young and mature trees. Adults feed on tender foliage
Zonocerus variegatus L. (Orthoptera: Pyrgomorphidae)	October –March	Found on both young and mature trees. Foliage feeders
Pachnoda cordata Drury (Coleoptera: Cetoniidae)	April-May	Found on mature trees.adults feed on young and mature apples, predisposing them to secondary infestation by Drosopholia spp
Homoecerus pallens F. (Hemiptera: Coreidae)	April-June	Found on young and mature trees. Adult suck sap and juice from shoots, young apples and nuts
Smaragdesthes guerini (Coleoptera)	April-July	Found on young and mature apples.
Sylepta derogata F. (Lepidoptera: Pyralidae)	January-May	Found on young and mature trees. Lays eggs in rolled up leaves. They are shoot feeders
Lema tibialis (Coleoptera:	April-June	Found on both young

Crioceridae)		and mature trees. Adults feed on tender shoots
Helopeltis spp (Hemiptera; Miridae)	January-August	Found on shoots, inflorescences, fruits and young nuts. They cause dieback in severe cases.
Analeptes trifasciata F. (Coleoptera:Cerambycidae)	September – January	Found on mature trees. Adults girdle stems and branches in a V- shape, which eventually breaks off
Smaragdesthes africanus	April-July	Found on young and mature fruits. Adults feed on fruits. Feeding predisposes fruits to rot organism and *Drosophilia* spp
Macrotermes bellicosus S. (Isoptera;)	September – April	Found on the trunk and root of young and mature trees. They tunnel into the root and distort the conducting tissues and also create entry points for rot organisms
Atelocera spinulosa (Hemipera: Pentatomidae)	June-August	Found on mature trees. Nymphs and adults suck flushing shoots and growing tips thereby weakening the plant.
Plaesiorrhina recurva (Coleoptera)	January – May	Found on fruits. Fruit feeders. Feeding predisposes fruit to rot organism
Anoplocnemis curvipes F. (Hemiptera: Coreidae)	October – February	Found on mature trees. Both nymphs and adults suck juice from young flushes, developing fruits and nuts. Damaged foliar , apples and nuts turn pale green and wither.
Dysdercus superstitiosus F.	April – August	Adults and nymphs

(Hemiptera: Pyrrhocooridae)		suck shoots and branches at the tips
Acrocercops syngramma Meyrick (Lepidoptera: Gracilariidae)	June-August	Found on tender leaves. Larvae mine into tender leaves, leaving tortuous markings. The thin epidermal peel swells up and eventually, the mined area dries up and falls
Plocaederus ferrugineus L. (Coleoptera: Cerambycidae)	Any time of the year	Attacks base of trunks of cashew tree. Larvae feed bore int wood tissue and feed on the sapwood.
Leptoglossus membranaceus F. (Hemiptera:)	January-April	Found on leaves. Sap sucker
Pseudotheraptus devastans Dist. (Hemiptera:Coreidae)	March – April	Found on both young and mature trees. Adults suck sap and juice from shoots, apples and nuts. Point of stylet insertion
		develops necrotic lesions that appear black, sunken, elongated spots on the epidermal tissue.
Aspavia armigera F. (Hemiptera: Pentatomidae)		Found on both young and mature trees. Sap feeders

TABLE 2: Mean values of temperature, relative humidity and rainfall at CRIN Head quarters from 2006-2008.

Month	Mean temperature%	Mean-relative humidity (%)	Mean rainfall(mm)
April 2006	24	74	104.4
May 2006	23	79	86.9
June 2006	23	83	244.5
July 2006	24.5	86.5	118.5
August 2006	23.5	91	93
September 2006	22.5	86.5	260
October 2006	23.5	83	166.2
November 2006	24	65.5	2.6
December 2006	23	64.5	0
January 2007	21.5	45.5	0
February 2007	26.5	57.5	28.8
March 2007	27	59	25.7
April 2007	27	70	49.1
May 2007	25.5	75	151
June 2007	25	80.5	221.7
July 2007	24.5	86.5	242.8
August 2007	23.5	85	150
September 2007	24	83.5	230.1
October 2007	23.5	79	156.1
November 2007	25.5	77.5	42.6
December 2007	25	74	4.9
January 2008	23.5	47.2	0
February 2008	24.5	45.8	0
March 2008	25.5	70.8	41.6
April 2008	25.2	72.4	23
May 2008	25.1	73.2	42.9
June 2008	25	77.7	224.9

Month	Mean temperature%	Mean-relative humidity (%)	Mean rainfall(mm)
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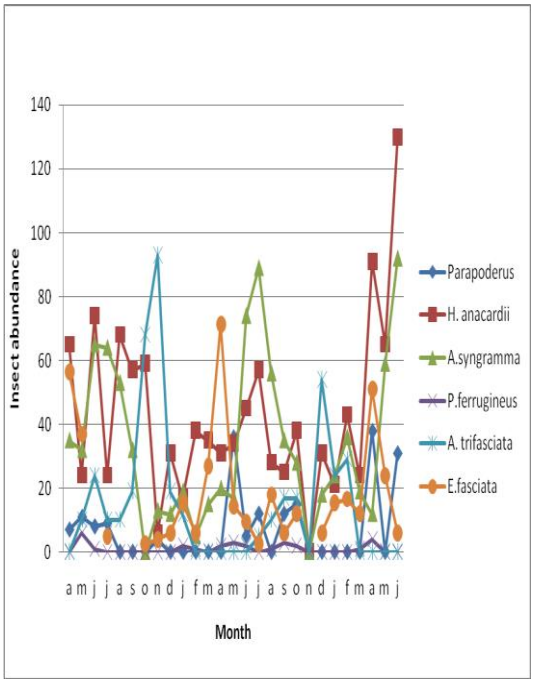

Figure 1: Seasonal distribution of some selected insect pests associated with *A. occidentale* in CRIN, Ibadan

LIBRARY INFORMATION AND DOCUMENTATION

The Institute Library provided information on CRIN Mandate Crops and discipline of scientist through acquisition of relevant information resources both test and electronics media.

Internet services to the institutes became more effective through deployment of V-sat network in the Institute with establishment of an ICT Centre.

Production of bulletins was carried out to bridge information gap between the management and the entire staff.

Proposal was submitted for the need to employ another Librarian for succession plan and the interview carried out in the same year. Another proposal was submitted for the library automation, using a free automation software.

Relevant local publications were acquired through purchases and published articles submitted by scientists' were listed in CRIDAN for easy referencing.

Photographs of scientific experiment and social activities were taken in the year, conferences and workshop were attended by staff of department

INTERNAL AUDIT

All the Financial Records, Store Records and Pension Records were audited during the year 2007 and all transactions were recorded according to all extant financial rules.

Procurement Audit was also carried out on most of the goods and services acquired during the period of report.

ENGINEERING GROUP

The year 2007 witnessed a successful execution of jobs

1. Mechanical Section (Automobile, Agricultural Equipment & Production Unit
2. Electrical Section
3. Civil (Building/roads/carpentry) section

Achievements

Listed below are jobs recorded.

1. Mechanical Section
   - Acquisition of ten(10) brand new project vehicles
   - Reticulation of pipes for water supply to the laboratory complex
   - Acquisition of new tractor for field work
   - Construction of tractor driven water tanker
   - Fabrication of burglary proof, iron gates and doors
   - Repairof 250KVA generator set.
2. Electrical
   - Maintenance of Air conditioners in the Institute.
   - Routine electrical engineering support to all segments of the Institute.
   - Maintenance of HT &LT equipment Viz. Transformers, RMUs, control panels, oil cooled circuit Breakers (OCBs) and Tripping units.
   - Regular maintenanceand rapid response to fault reports in the offices and quarters.
   - Repair/maintenance of power house generators.
3. Civil (Building/Roads)
   - Maintenance of roads by the road maintenance team, filling of pot holes with granite etc.
   - Regular maintenance of residential quarters.
   - Renovation of buildings in J.S. quarters, T.O. quarters.
   - Construction of farm houses for zones.

PLANTATION AND ESTATE MANAGEMENT CRIN HEADQUARTERS, IBADAN

Mrs. J. Olufemi Agge
Plantation Manager

I INTRODUCTION

There are two major units in the plantation and management section namely.

Unit I: Consists of seven zones where plantations of our mandate crops are situated.

Unit II: Consists of the ground maintenance which is involved in:

a) The general maintenance of Institute's internal and external environment.
b) Maintenance of Horticultural/ornamental plants
c) Landscape design

II PLANTATION ACTIVITIES

1) Weeding (manually and chemically controlled)
2) Supply of missing stands
3) Removal of mistletoes/moribund plants
4) Pruning of canopies
5) Watering of young cocoa plots
6) Rehabilitation of cocoa plots
7) Cutting of fire traces
8) Preparation of mini cocoa nursery in the zones to solve problem of transporting seedlings during the rainy season
9) Cutting of fire traces round the plantations and the ERLS buildings
10) Maintenance of the Institute's environment such as the office/laboratory complex, DI and DDI quarters, Rest House/Charlet building, Junior and Senior Staff Club, Health Centre, Football Pitch, Road sides from the main gate to the central Nursery, roadsides of S.S and T.O. quarters, water works road via zone 9.
11) Planting and maintenance of hedges and ornamentals (plotted ones inclusive)
12) Harvesting and processing of viable farm produce for sales and Research purposes. A total number of 263,059 cocoa pods, 28,3333 cashew nuts, 283 palm fruits 10,300 kola nuts, 113 bunches of Banana and 30 bunches of plantain were harvested. Table IV shows the details.

III RESEARCH ACTIVITIES

Research officers who had their experiments in the different zones were assisted as requested in the following aspects: slashing of experimental sites, felling and cross cutting of forest trees, marking out and pegging, holing, weeding, coppicing of coffee trees, fertilizer application, harvesting and data collection. It has been observed towards the last quarter of the year that some researchers have neglected their experimental plots without notifying the zonal team leaders hence leaving the plots bushy. Such individuals will soon be written concerning the situation of the plots.

IV REVENUE

Details of revenue from farm produce harvested from the plantations and marketed by the Marketing Unit are shown on Table (IV) out of the total sum of Two million one hundred and forty five thousand, five hundred and thirty naira (₦2,145,530) revenue generated by the Institute's headquarters in year 2007, Two million and forty five thousand, seven hundred and thirteen thousand naira (₦2,045,713) was generated from plantations.

V PERSONNEL

The total number of members of permanent and casual staff during the year was One hundred and fifteen (115). Table V shows the details. Ten officers left the service before the end of the year. Three (3) of them retired after successful completion of service while seven were retrenched. To the glory of God no death was recorded.

VI PROBLEMS/SUGGESTED SOLUTIONS

1) Inadequate manpower which is affecting the output of work done. If this is solved, the revenue form the farm produce will be greatly improved. The plantation is

pregnant with revenue but lack input which can prevent abortion. This can be solved by purchasing herbicides insecticides and fungicides. Mowers and slashers can be purchased for the Ground maintenance unit. There should be increase in manpower.

2) Lack of transportation to convey workers from the main office to their different zones. A separate vehicle for the PEM section will solve this problem. This will minimize the quantity of fuel consumed by having full control on the purchase and usage. Complaints of faulty vehicle will also be minimized.

3) The Plantation is porous. Farm produce are being disturbed and stolen. If Plantain bunches are not matured, they will not be marketable, thieves always prevent us from harvesting marketable plantain and banana. Even cocoa pods, kola nuts and others are not left out. Security van can start patrolling the zones after official hours and week ends. For instance bulk harvest of plantain came from the central nursery where we have security men on 3 shift duty.

4) The Old constructed zonal offices need renovation and some of the new ones under construction should be completed (especially the toilets).

5) Workers need incentives to increase productivity. This can be done by presenting gift quarterly or yearly to the best zone in respect of yield, maintenance and punctuality.

6) Late payment of wages to workers. Early payment of wages to workers will encourage them and enhance productivity.

TABLE 1: HARVESTING RECORD OF COCOA PODS – JANUARY – DECEMBER 2007

MONTH	TOTAL NUMBER OF PODS
JANUARY	26,459
FEBRUARY	7,163
MARCH	7,550
APRIL	21,693
MAY	29,300
JUNE	1,578
JULY	-
AUGUST	112
SEPTEMBER	705
OCTOBER	22,867
NOVEMBER	107,044
DECEMBER	38,588
TOTAL	**263,059**

TABLE 2: COCOA PODS SUPPLIED TO COCOA GROWING STATES (NCDC PROGRAMME) JANUARY – DECEMBER 2007

STATE	NUMBER OF COCOA PODS COLLECTED
OGUN	4,400
OSUN	2,610
KWARA	3,000
OYO	9,950
EKITI	1,200
EDO	300
TOTAL	21,460

TABLE 3: BREAKDOWN OF COCOA YIELD RECORDS JANUARY – DECEMBER 2007

1 S/NO	2 MONTH	3 TOTAL PODS HARVESTED	4 No OF BACK PODS	5 DAMAGED	6 NO. OF PODS COLLECTED	7 No. OF POD FERMENTED	8 WET WEIGHT	9 WET WEIGHT	10 DRY WEIGH DRY FERMENTATION
1	JANUARY	26,459	3,178	2,426	10,550	9,820	863.4	773.8	282.8
2	FEBRUARY	7,163	930	1,082	2,705	2,188	188.6	168.0	39.1
3	MARCH	7,550	1,218	1,014	1,420	3,427	305.0	279.6	106.8
4	APRIL	21,693	2,885	2,078	9,441	6,502	525.8	494.3	191.8
5	MAY	29,300	3,705	2,197	14,469	8,505	567.4	511.2	170.0
6	JUNE	1,578	542	399	.	.	.	.	.
7	JULY	.	.	.	.	.	.	.	.
8	AUGUST	112	.	.	112	.	.	.	.
9	SEPTEMBER	705	198	71	.	570	57.6	42.2	18.2
10	OCTOBER	22,867	3,482	1,471	100	19,433	1888.1	1586.6	645.8
11	NOVEMBER	107,044	9,870	5,330	10,516	81,502	7713.2	6884.1	1936.1
12	DECEMBER	38,588	2,580	2,050	9,550	24,410	2282.8	1990.0	694.8
	TOTAL	263,059	28,588	18,118	58,863	156,357	14391.9	12729.8	4085.4

TABLE 4: REVENUE GENERATION FROM FARM PRODUCE IN THE PLANTATIONS

FARM PRODUCE	QUANTITY	AMOUNT (₦)
Cocoa beans	6 tones, 5kg	950,988.00
Cocoa pods	111,052	319,150.00
Cocoa seedlings	8,391	209,775.00
Kola seedlings	414	20,700.00
Plantain suckers	700	17,500.00
Plantain	123 bunches	36,900.00
Palm fruits	283 bunches	42,450.00
Coffee seedlings	7	105,000.00
Coffee seed	45kg	22,500.00
Cashew nut	489	233,250.00
Cashew seedlings	10	300.00
Kola nuts	10,300 nuts	4,800.00
Maize	725 cobs	2,500.00
Fire wood	-	8,000.00
Banana	34	3,400.00
African star apple	8 trees	16,000.00
Wood (logs)	-	50,000.00
Palm tree tapping	10	2,500.00
Total		**2,045,713.00**

TABLE 5: PERSONNEL DISPOSITION OF P. E. M AS AT JANUARY, 2008

ZONES OF LAND	CAS	ACAS	PASI	PASII	CAFO	SAFO	AFO	AFAI	AFAII	GANG-OF CASUAL WORKERS	COCOA	CO	CA	C/TY	TOTAL	HECTRAGE
P.E.M.1	1	-	-	-		1	3	-		39		1	1	1	48	
G/M	-	1	-	-	1	-	1	13	-	-		-	-	-	17	ref.
plantation activities																
1	-	1	-	-	1	1	1	5		-		-	-	-	9	11.5
2 & 3	-	-	1	-	-	1	1	6	-	-		-	-	-	8	56.1
5	-	1	-	-	-	1	-	5	-	-		-	-	-	6	15.72
6	1	-	-	-	-	-	-	5	-	-		-	-	-	6	53
7		-	-	-	1	-	-	6	-	-		-	-	-	7	16.98
8	1	-	-	-	1	-	-	6	-	-		-	-	-	8	61
9	-	1	-	-	-	-	1	5	-	-		-	-	-	7	30.3
Total	3	5	1	-	4	3	4	54	-	39		1	1	1	115	

KEY:

C. A. S: Chief Agricultural Superintendent
A. C. A. S: Assistant Chief Agricultural Superintendent
P. A. S: Principal Agric. Superintendent
C. A. F. O: Chief Agric. Field Officer
S. A. F. O: Senior Agric. Field Officer
A. F. O: Agric. Field Overseer

MAMBILLA SUBSTATION

(1) LAND MATTER

Kusuku

Land trespassing by two members of the community namely Timothy Buba and Manasis Jorsah were recorded in 2007.

(2) FARM MANAGEMENT AND AVAILABILITY OF WORKING TOOLS

Kusuku

Field activities were regularly carried out included: (i) weeding /slashing of coffee and tea plots,
(ii) spraying copper sulphate and lime on coffee bushes to control Coffee Berry Disease, and
(iii) application of urea fertilizers to tea plots.
In 2007, tea and coffee yield were 3,383 kg and 400 kg respectively.

Mayo-Selbe

Weeding on cocoa and tea plots was carried out except that there was no chemical for pest control on cocoa.

(3) STATE OF RESEARCH & RESEARCH FACILITIES

a. **Field**

Plantation rehabilitation

Of the fifty-four surviving *C. arabica* genotypes, only four genotypes that carried berries in 2007, were replanted. Further work need to continue on the replanting of other surviving genotypes. The on-going research activities in the Substation are as stated in Table 1.

(4) PERSONNEL MANAGEMENT

The staff strength was 23 in 2007 (Table 2). Two workers namely: Mr. Samuel Rifor and Mr. Abraham Dide died in 2007.

(5) RESIDENTIAL QUARTERS AND REACREATIONAL FACILITIES

The Club House is currently a good place of recreation for the staff and the community. Public-Private partnership arrangement was employed to improve the management of the club house.

(6) TECHNOLOGY TRANSFER / EXTENSION SERVICE UNIT

Meetings of National Coffee & Tea Associations of Nigeria (NACOFTAN) and All Farmers Association of Nigeria (ALFAN) were regularly attended in Gembu and Jalingo respectively. In the meetings, farmers were briefed of high yielding varieties available in the Substation and their need to contact the Substation for their planting materials.

(7) MAJOR CHALLENGES

a. Trespassing into CRIN land by community elites.

b. High cost of fuel in Mambilla.

Table 1: List of on-going experiments at CRIN Substation Mambilla

S/N	TITLE OF EXPERIMENT	SIZE (HA)	YEAR ESTABLISHED	RESEARCHER	REMARKS
1.	Mophological characterisation of 86 selected *Coffea arabica*	1.5	2003	Dr. Omolaja	In progress
2	The application of organic and inorganic fertilizers to *C. arabica* germplasm	1.5	2005	Dr. O. S. Ibiremo	In progress
3.	Determination of factors favourable to the production of rooted cuttings of *C. Arabica*		2005	Dr. Omolaja	In progress
4	The effect of boron, inorganic and organic manures on tea at seedlings and adult stages.		2005	Dr. R. R. Ipinmoroti	In progress
5.	Effect of organo-mineral fertilizer on tea product.	0.5 ha.	2003	Dr. Ipinmoroti	In progress
6.	Effect of tea/maize inter-crop on tea performance	0.5 ha.	2003	Mr. Oloyede & Dr. Ipinmorti	In progress
7	Effect of tea/eucalyptus inter-crop on tea yield and quality	0.4	2002	Dr. Omolaja & Dr. Ipinmoroti	In progress
8	Management of tea under eucalyptus.	0.2	2002	Mr. A. Oloyede	In progress
9	Shade experiment on coffee	0.5	2004	Dr. Famaye	In progress
10	Selection of cocoa clones for drought tolerance	0.2 (Mayo-selbe)	2005	DR. Omolaja & Dr. Aikpokpodion	In progress
11	Hybridization study in tea		2006	Dr Omolaja & Mrs Muyiwa	In progress

Table 2: CRIN-MAMBILLA Substation staff disposition

S/NO	NAME OF STAFF	DESIGNATION	LOCATION	HATISS	DUTY
1	Dr. S. S. Omolaja	ACRO	Kusuku	12	Head of Station
2	Mr. Fredrick N. Chila	HAS	"	7	Field duties
3	Mr. Jesse Mbonyel	HAS	"	7	" "
4	Mrs. O. L. Magaji	Executive Officer (Accts)	"	6	Account duty
5	Mr. J. D. Magaji	Chief Clerical Officer	"	6	Store duty
6	Mr. Augustine Mari	Assist. Agric. Supt.	Mayo-selbe	6	Field work
7	Mr. Peter Numfor	Typist Grade 1	Kusuku	5	Secretarial duties
8	Mr. Emmanuel Mimba	Driver/Mechanic	"	5	Driving
10	Mrs. Elisabeth E. Kawas	Senior Clerical Officer	"	3	Admin. Duties
11	Mr. Husseini Usman	Health Assistant	"	3	Drugs Dispensing
12	Mr. Yohana Wabbi	Security Guard	Mayo-selbe	3	Security duties
13	Mr. Usman Abdullahi	Agric. Field Overseer	" "	3	Field work
14	Mr. Ahmed Y. Sardauna	Assistant Clerical Officer	Kusuku	3	Accounts duties
15	Mr. Francis J. Wakaps	Assistant Craftman	"	2	Mechanical Engin.
16	Mr. Ephesian Thomas	Security Guard	"	3	Security work
17	Mr. Moses Danfulani	Agric Field Overseer	"	3	Field work
18	Mrs. Satu Musa	" " "	"	3	" "
19	Mrs. Namaiah Peter	" " "	Kusuku	3	" "
20	Mrs. Philina Stephen	" " "	"	3	" "
21	Mr. Joseph Nuki	Watchman Guard	"	1	Security job
22	Mr. Augustine David	Agric. Field Attendant 2	"	1	Field work
23	Mrs. Anister Lawal	" " "	"	1	" "

CRIN OWENA SUBSTATION

Preamble: Activities at the station started at a low ebb as there was no fund to effectively carry out our activities. However, the routine activities such as nursery operations and field maintenance were regularly carried out. Activities at the station picked up following a change in the headship of the station. The following activities were carried out sequel to the release of some fund.

1. **Seed Garden Establishment:** Two-hectare cocoa seed garden site was begun. The garden started with activities such as weeding, felling of trees, cross-cuting of trees, packing, lining and pegging, holing for plantain, planting plantain suckers and maintenance of the suckers during dry season by watering and weeding . Activities regarding the seed garden plot were regularly

reported to the head quarters by the Head of station.

2. **Tractor Donation by the Niger Delta Development Commission (NDDC)**

The Ondo State office of NDDC graciously donated a tractor to the station as part of their effort to empower institutions in the state. CRIN Owena was lucky to benefit from such gesture as it was the only research institute in the State that benefited from such largesse. The station collaborated strongly with Ondo State Commissioner on the Board of NDDC so that CRIN can develop a mutual relationship with the commission that will in turn benefit the good people of Ondo State.

Vehicle: At the beginning of the year, the station has one Mitsubishi pick-up van and a tractor. The two vehicles are still in good working condition but they are very old. However, towards the middle of the year under review, the station was given a new Toyota Hilux 2.7 Van WTI thus bringing the number of our vehicles to two but the management later felt that there is need to equitably distribute resources among the substations, the old Mitsubishi van was later withdrawn and was given to Ibeku Substation in Abia State.

Revenue: Our station generated the sum of six hundred and forty-eight thousand, seven hundred and sixty naira (₦648,760.00) as internally generated revenue for the year, from the sales of farm produce and other allied services (see below table).

S/N	Item	1st Quarter ₦	2nd Quarter ₦	3rd Quarter ₦	4th Quarter ₦	Total ₦
1	Cocoa Beans	-	27,280.00	67,160.00	41,720.00	136,160.00
2	Cocoa Seedling	125,000.00	-	125.00	-	126,250.00
3	Cocoa Pods	4,560.00	6,600.00	6,600.00	52,800.00	70,590.00
4	Plantain & Banana	4,900.00	-	2,300.00	4,000.00	11,200.00
5	Rent (i) Payroll	24,500.00	24,000.00	23,000.00	25,000.00	96,500.00
6	(ii)Tenants	8,750.00	16,250.00	14,700.00	30,750.00	70,450.00
7	Light (i) Payroll	9,300.00	8,750.00	8,280.00	8,990.00	35,160.00
8	(ii) Tenants	9,600.00	9,750.00	11,700.00	7,650.00	38,700.00
9	Tractor service	3,000.00	-	-	-	3,000.00
10	Rest House	2,500.00	5,500.00	1,250.00	-	9,250.00
11	Felling of tree	-	-	30,000.00	20,000.00	50,000.00
12	Ogbono-tree	-	-	-	1,500.00	1,500.00
	Total	-	192,110.00	98,110.00	166,240.00	648,760.00

Staff Disposition: The present staff strength at the station as at December 2007 was sixteen as two members of staff were retired by the government through the National Reform Programme. The station maintains only seven (7) casual staff in Owena and its four out stations. It was very difficult for the station to meet up with the challenges of field maintenance at these locations.

Research Activities: At present, no research activity is going on at the station. Most research activities have either been terminated perhaps due to completion of study or no proper handing over and the scientists involved from the headquarters have not shown up. Although, there are indication that some of our scientists may likely site their trials at our station in the coming year.

Constraints and suggestions for improvement: The plantation in our stations are too large for the few casual staff on ground coupled with the fact that the institute has not sent anything as overhead throughout the year. The following are therefore suggested as way forward in this situation.

1. **Release of fund**: Prompt release of fund to the station is very necessary to maintain both existing structures and the plots. Most of our structures are in a

very bad state, there is need for repairs on most of them. In addition, the plantations are in the bush (more than 60%) and money should be made available to recover them especially the high quality cocoa materials of Ibule and Owena.

2. **Lease-hold of Plantations:** The suggestion above is very desirable but what about its sustainability? If we are to borrow a leaf from the Ondo State Tree Crops Unit, most of its plantations are leased out to competent farmers and on agreed sharing ratio. This is paying off as almost all its plantations are in good shape. The unit is only responsible for chemicals and other minor operations.

CRIN IBEKU SUBSTATION ANNUAL REPORT

1. **Field operation**: Routine Management operations viz-a-viz, slashing, pruning , chemical spraying against pest, diseases and control of weeds, harvesting, processing of farm produce were carried out during the year under review in all the maintained plots within the Estate both at Ibeku and Ugbenu in Anambra State. Ground maintenance of office area and farm roads was carried out.

2. **Physical development**: The broken ceilings in OIC's office, the Chief Typist and the Accounts offices were repaired. However, one wooden door, one Iron door protector and two Iron window protectors were constructed for the Chief Typist office and extra two Iron window protector for the Storeman remaining office. I wish to state further that there is need to repair the main office block at Ugbenu because of the deteriorating condition of the building. At least re-roof one room for the workers as office.

3. **Seed garden programme**: A team led by Dr. Peter Aikpokpodion from CRIN Headquarters came to Ibeku Substation to select a 2 hectare site for the Establishment of Cocoa Seed Garden. Such was extended to Abia State/Akwa Ibom State Ministry of Agriculture respectively. We are seriously waiting for the fund and take off of this project.

4. **NCDC**: Grand total number of 15,810 (fifteen thousand, eight hundred and ten) healthy cocoa pods was supplied to Akwa Ibom State through their Cocoa desk officer – Mr. Joe Archibong and Abia State through Deacon Sam Odoemena, for the programme. The number had been send to the Executive Director, through Dr. E.O. Aigbekaen, formal Co-ordinator.

5. **Revenue generation (IGR)**: The sum of N224,742.00 (Two hundred and twenty-four thousand, seven hundred and forty-two naira) only was internally generated for the year, 2007. The comprehensive detail of the revenue generation is shown below:

PARTICULARS	1ST QUARTER	2ND QUARTER	3RD QUARTER	4TH QUARTER	TOTAL
Cocoa beans	3,485.	-	-	146,232.	149,717
Cocoa pods	24,000.	-	-	30,000	54,000
Banana	500.	100	-	-	600.
Ogbonor	2,950.	-	-	-	6,950.
Pineapple	275.	-	-	-	275.
Maize	-	900.	-	8,550.	9,450.
Cashew nut	-	6,220.	-	-	6,220.
Oranges	-	-		830.	830.
Malong (Egusi)	-	-		300.	300.
	N31,210.00	N7,220.00	-	N185,912.00	N224,742.00

N:B. 15,810. Cocoa pods supplied this year 2007, to Abia State and Akwa Ibom State should have been part of our revenue if processed and dried. On the other hand, if estimated as CRIN sales = 15,810 x N60 per pod will give us N948,600 each as revenue.

6. **Staff and labour disposition**: The staff strength stood at twelve (12) as at 31st Dec., 2007, four senior staff, and eight (8) junior others. The casual workers remained Nine (9) including two security men at Ibeku,

none at Ugbenu. This number is grossly inadequate for Ibeku and Ugbenu plots.

7. **Wages**: The wages for the casual workers were not sent all through the fourth quarter. I 'm pleading with the management to do something, for a hungry man is an angry man.

8. **Extension activities**: During the year some farmers' farm were visited on request to access their Cocoa rehabilitation problems. Where possible recommendation on the spot were given to the farmers as regards what to do. Students of Michael Okpara University of Agriculture came for some Research Questions, in cases like this, I do refer them to the Headquarters. There was established programme for Cocoa Farmers' School, organized by IITA/STCF and Abia State Ministry of Agriculture in CRIN Ibeku Substation this year. The substation was invited for the first Convocation Ceremony of the Abia State Cocoa Farmers' School.

9. **Transportation**: The year 2007, the substation witnessed a very serious harsh condition in term of vehicle maintance in Ibeku Substation. The Peugeot 404 pick- up as I learnt has been in the Institute for the past 26 years and is very old. It has been grounded since 2006. The landlord where this vehicle was parked is lamenting for the removal. The Hilux Van FG 508 S03, was re-located to Ibeku since 2003, from Uhonmora CRIN Substation. From its day one in the office, it keeps on developing one engine problem to the other. Since August 2007, it broke down along the road near the Umuahia North L.G.A. We decided to push it to the L.G.A. premise for at least safe keeping. For several times the Chief security officer of the L.G.A. has contacted me to know when I would come to remove the bad vehicle from their parking lot. Thank God, just last Oct., 2007 another L200 pick-up FG 742 BO3 was given to the substation on borrowing from Owena Substaion. I'm suggesting that the old peugeot 404 pick-up be auction and the Hilux van diesel engine changed to petroleum engine. Above all, the Institute needs a Brand New Vehicle considering that none of us residing in the Government quarters are mobile the road network to our office is so bad.

10. **Court Cases**: With the Management approval for settlement out of Court, lawyer and prosecutor incharge have informed the Court for settlement. Court in turn has asked the village representatives to prepare their under taking for the boys to sign, the copies of such should be given to the Court, CRIN and the village, and then 29th and 30th Jan., 2008, to report settlement.

11. **Health Care**: Drug allocation from the headquarters is on regular basis. Our major problem here is a dispenser, Mrs. Chika Ukaegbu a nurse had been recommended since she is a trained nurse. I shall be grateful sir, if this can be effected.

12. **Block of Flat/Piece of Land**: (From Abia State Govt); The piece of land and block of flat promised CRIN, by the State Government since 2006, has not been released yet. Several contacts have being made by the OIC, of course recently the Management has written a reminder to both the Executive Governor and the Commissioner of lands.

13. **Retirement of Staff**: One of our staff, Mr. R.A. Odozor of Ugbenu experimental plot successfully bowed out of Public Service this year, we wish him on behalf of the CRIN, Management happy and successful retiring period.

14. **Visitors**: Some visitors to the substation this year includes: participants of Abia Cocoa farmers' School, Deacon Sam Odoemena, Mr. J.E. Archong,Dr. I.E. Okuku (IITA) Bertha Ochiuwa (BCA Newa Crew) Hon. Commissioner of Agric. Hon. George Nnanna Kalu, Revd. J.U. Nwanwo, Mr. Ojoneh Sunday (NHIS), Dr. Peter Aikpokpodion, Ogunlade Moses, Enagu Victor, Hon. Emeka, S.M., Akin Oluwalade (MD IITA/STCP) and Auditors from CRIN Headquarters.

15. **Problems & Constraints**: As highlighted in my Quarterly reports, I shall be grateful if the following problems can be looked into:-

    1. Wages for Casual workers both field and security gaurds for the 4th quarter should be sent.
    2. Our work force should be beafed up and the 1st batch of casual workers that has lasted over eight years converted to permanent staff.
    3. Ibeku substation needed a new vehicle that can withstand our bad road net work.
    4. Arrangement should be made from the Headquarters on how to send down the old bad vehicles in Ibeku back to the headquarters for the landlords where these vehicles are parked are really disturbing.
    5. One pit toilet for Ibeku Substation is an urgent need.

CRIN UHONMORA SUBSTATION

Physical Development: The following Junior Staff Quarters: JSB 21, JSB 23, JSB 25, JSB 67, JSB 68 JSB 69 and JSB 70 were renovated in the year 2007 despite the fact that there was no capital allocation given to the Substation. The quarters are now available for leasing out to CRIN workers and CRIN Primary School Teachers that are already shown interest.

Infrastructural Devlopment

Peugeot 504 Station Wagon repaired in November, 2006 was regularly serviced and assisted in local running in 2007. A new Toyota Hilux Double Cabin 4WD with registration number FG 677 B03 was released to the Substation on 27th July, 2007 by the Executive Director.

Street lights were put from the office to the main gate and other major streets in the quarter in april, 2007.

Revenue: A grand total of seven hundred and ninety-three thousand, seven hundred and sixty-one naira fifty kobo (N793761.50) was generated in the year 2007.

The details is as shown below:

Items	1st Qrts	2nd Qrts	3rd Qrts	4th Qrts	Total
Palm fruits	11,400	4,400	6,000	5,000	26,800
Rice	32,500	-	20,000	44,000	96,500
Cocoa pods	75,360	600	-	37,030	112,900
Plantain bunch	12,300	-	-	7,500	19,800
Rubber	2,620	-	1,500	-	4,120
Cocoa seedlings	16,000	69,500	13,500	-	99,000
Cocoa beans	15,000	-	-	77,571.50	92,571.50
Oil palm seedlings	10,000	1,400	-	-	11,400
Cocoanuts	390	-	90	-	480
Cashew Nuts	-	1,250	-	-	1,250
Cassava Tuber	-	16,350	-	-	16,350
Timber	-	1,000	-	-	1,000
Vegetables	-	30	-	-	30
Pineapples	-	50	-	-	50
Maize	-	-	10,270	-	10,270
Rubber Rentage	-	-	-	3,000	3,000
Oil Palm Mill	-	-	-	200	200
Kola nut	-	-	-	60	60
Grape Orange	-	-	-	100	100
*Felling of trees	-	-	-	12,000	12,000
Rest House Rentage	-	-	2,000	2,000	4,000
Rice Land Rentage	-	-	-	70,500	70,500
Gate Pass on Rice/Timber	-	-	18,300	6,050	24,350
Quarter Rentage	46.580	46.120	46.860	47.080	186.640
Grand total	222.150	140.700	118.520	312.391.50	793.761.50

*Illegal Trees Felling of Subchanrge (N12,000)

Staff Disposition and Welfare

The staff strength as at 31st December, 2007 was made up of 4 Senior Staff, 18 Junior Staff and 9 daily rated labourers making a total of 31 workers. Mr. Odusote, A.A, PEO.II (Accts) was transferred to CRIN Headquarters in May, 2007 and Mr. Adekojo, S.A., E.O. (Accts) was transferred from Headquarters at the same time to replace him.

There was no member of staff retired or promoted in 2007

During the period, six hundred and ten (610) patients received treatment at the Substation's Dispensary.

The inter- personal relationship between the workers was very cordial during the period.

Research Activities and other Operations

The following Research Experiments were set up in the year 2007.

a. Coffee/oil palm
b. Coffee higher density
c. Cocoa higher density
d. Cocoa/rice intercropping
e. Coffee/rice inter cropping
f. Cashew/rice
g. Evaluation of period of cropping on coffee. Regular data collection was also embarked upon in 2007 on all these experiments listed above.

Other operation done within the period under review include the gapping up of 2 hectares new cocoa plantation (D2) established in 2006 as well as other plots, A3, C2 and 133.

Seedlings were used for the gapping up of all the missing/dead stands in the year 2007.

One thousand, two hundred and ninety-two (1,292) plantain suckers were used as shade plant for both experimental and newly established plots.One hectare each of maize and cassava were cultivated to boost arable crops production. Hired climber was used to harvest the palm fruits. They were sold to increase the revenue generation of the Substation in 2007.

Rainfall Data- January to December, 2007

Months	Rainfall (mm)	No. of Days
January	-	-
February	42.0	4
March	71.8	4
April	111.3	4
May	215.2	10
June	245.4	13
July	306	18
August	150.1	16
September	425.8	19
October	185.2	12
November	0.7	1
December	215.5	2
	1,775.8	103

The rainfall data for 2007 was 1775.8mm in 103 days.

Plantation Management Maintenance: Weeding of all the newly established and old existing plots were carried out throughout the year 2007. Flowers were planted on the roadside from the main gate to theoffice to add to the beauty of the Estate. Ground quarters maintenance, farm roads, pineapple orchard,office environment, spraying against insect pests, harvesting and processing of farm produce were also carried out. Cutting of mistletoes was done. Fire traces were cut around the plantation as means of checking fire hazards into our plantations.

Extension Activities: farm visit was made during the year under review and prominent among them wasMr.Oiseomoje Aideloje at Sabongida Ora a season farmer, I equally attended the meeting of CFAN and CAN at Sabongida-Ora and Iruekpen.They were enlightened on CRIN new findings. They were equally advised to visit our Substation whenever they have problems on their farms.

Mrs. Emenofu, O.Y. an NYSC with Folad Farm Limited, Uhonmora came for information on our mandate crops in October, 2007.

Pension Pay Parade Auditing: The team led by the Institute's Administrative Secretary Mr. J.O. Babafemi, including Mr. S.O. Adefaka (Chief Accountant), Chief Ogunbayo, Mrs.P.A. Ibebe and the Executive Director Prof. G.O. Iremiren was in the Station from 8th , 9th and 10th August, 2007 for thePension Pay Parade.

Special Request: The staffing of the casual workers in the Substation and the posting of two additional Agric. Superintendents to join the only one is humbly requested from the Executive Director and his management team.

Appreciation: On behalf of the entire staff, I hereby express our profound gratitude and appreciation to the Executive Director for providing the Substation with a new Toyota Hillux double cabin with Reg.
NO. FG 677 B03 in July 2007.

Visitors: These under listed people visited the substation in 2007.

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Staff

1. Dr. S.O Agbeniyi
2. Mrs. M.P Iyang
3. Mr. E.O Bakare
4. Mr. A.B. Adigun
5. Miss Pauline Patrick
6. Mrs. Eunice Ojua
7. Mr. Moses Bassey
8. Mrs. Rosemary Okon
9. Mrs Ekama .B. Isong
10. Mr Okon Okpo
11. Mr Innocent Ugbaoha
12. Mr Godwin Ogbajo
13. Mr Victor Echhena
14. Mrs Esther Echi
15. Mr Ezekiel Effiong
16. Mr Ekong .U. Ekong
17. Mr Emena Iloko
18. Mr John .E. Asuquo
19. Mr Effiong .N. Udoh
20. Mr Iganatus Ajito
21. Mr Edet .K. Akpan
22. Mr James .P. Okoi

Infrastructural Facilities
33 JSS block, 3 T.O block, 2 senior staff block, 2 - office complex , 2- Rest House 1 junior staff club House

1 borehole	Functioning
Toyota Hilux	Functioning
Tractor	Functioning
Mecedece Tanker	Functioning
Mustibus L 200	Functioning
Peogeot 404	Not functioning
Bedford Lorry	Not Functioning
Eicher Truck	Not functioning

Metrological Station
No functioning equipment

PLANTATION:
A. Total Hectarage CRIN Ajassor -768 hectares
B. Total Cultivated Hectarage-88.01 hectares
B i Cultivated Crops/Hectarage:
B ii (Cocoa) Ajassor 50.43 ha
,, Okondi -13.29 ha
,, Kalime T 38 - 2.8 ha
,, CRIN /CFC Plot -1.8 ha
Total for Cocoa - 68.32 ha
Kola Ajassor-16.1 ha
Coffee Ajassor -1.57 ha
Coffee Okondi -1.46 ha
Total for Coffee -3.03 ha
Tea - 0.16 ha

B iii Plantain plots/Oil Palms (2003/2004) - 0.4 ha

Moribund and Abandoned plot

1. Kola Progeny
2. Trinidad Introduction
3. Farming system
4. Coffee plot
5. Cashew plot
6. Kola fertilize trial

Special Project

2- hectares seed garden plots were established.

The following operation were carried out during the year

1. Fire Tracing
2. Pruning
3. Removal of mistletoe
4. Spraying of fungicides and insecticides for black pod and mirids control
5. Harvesting

Research Work

1. Herbicide Screening trial
2. Fungicide Screening trial

Problem encounterred

1. Land Encroachment
2. Poor funding of substation-
3. lack of infrastructural amenities
4. No good roads, electricity, laboratory
5. Library
6. Inadequate manpower'

Recommendation

1. Proper land survey and fencing of quarters
2. Good funding of substation

FINANCE & ACCOUNTS

The financial period under reference was broken down into four quarters.
Financial returns, including remittances of Internally Generated Revenue (IGR) been made to the Headquarters.

Apart from staff salaries and allowances which were remitted from the Headquarters and paid to staff at the substation, there was no remittance of overhead to the substation for the entire year under review; hence the only source of fund available to the station was the internally generated revenue

Generation of revenue at the station was consistent at an average of N170,000.00 per quarter. While the total sum of N160,956.00 was remitted to the coffers of the institute for the year under review.

The Station maintained a current account with UBA bank Ikom Branch for all her transactions and had a credit balance of N449,915.83 as at 31st December, 2007. This balance is inclusive of the sum of N73,000.54 being cheques already issued but not yet presented to the bank for payment.

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