Integrated Pest Management Reviews **7:** 165–172, 2002.

Responding to economic crisis in sub-Saharan Africa: New farmer-developed pest management strategies in cocoa-based plantations in Southern Cameroon

O. Coulibaly[1], D. Mbila[1], D.J. Sonwa[1,2,*], Akin Adesina[3] & J. Bakala[4]
[1]*International Institute of Tropical Agriculture Biological Control Center, P.O. Box 08-0932 Cotonou, Benin*
[2]*Department of Plant Biology, University of Yaoundé I, Cameroon*
[3]*Rockfeller Foundation, New-York*
[4]*Institut de Recherche Agronomique pour le Developpement (IRAD), P.O. Box 2123 Messa, Yaoundé, Cameroon*
[*]*Author for correspondence: (E-mail: iita-humid@iccnet.com)*

Key words: cocoa, economic crisis, integrated pest management, pest control

Abstract

Cocoa is a key or source of income and poverty reduction in the humid forest of Southern Cameroon. Cameroon like other African countries went through a major economic crisis in the early 1980s with a decline in international commodity prices and significant changes in macroeconomic policies. Structural adjustment reforms following the economic crisis led to removal of fertilizers and pesticides subsidies, cocoa price liberalization and the overall withdraw of Government interventions from the cocoa sub-sector. Cocoa input price increases have been compounded by the devaluation of the CFA Franc, which doubled the prices of the imported pesticides which were considered key to the control of cocoa pests. This overall economic shock led to changes in cocoa producer's production decisions as a response to minimize cost. Among the changes the use of alternatives to imported chemicals for cocoa pest control. Farmers responded to the high prices of pesticides by developing, from local botanical knowledge and pest management strategies, which include plant extracts and plant extracts mixed with pesticides at different proportions. This is a major decision given the importance of imported chemical in the cost of production of cocoa. Valuable indigenous knowledge from farmers could be used also as an effective support system for communicating and diffusing modern knowledge and technologies to farmers. The paper describes the farmer knowledge-based alternatives to chemical pesticides for pest control in cocoa fields as a response to high pest control costs. Pest management specialists are urged to take advantage of this shift in practice and assess their effectiveness for further use. Two sets of questions are posed: (1) were the conventional insecticides, with all their problems, really necessary? and (2) are the materials derived from locally grown plants effective pest management agents or are they, in some way, placebos?

Introduction

Cocoa (*Theobroma cacao*) is one of the most important export crops in Cameroon. It has been introduced in the country in 1886 (Nnama 1995) and became not only the most important cash crop in the humid forest zone, but is considered a prestigious crop to claim land ownership (Weber 1977; Leplaideur 1985; Ruf 1987). Constraints to cocoa production in Cameroon are of several kinds, but insects and diseases are reported as the major production constraints as Government withdrew from supplying subsidized pesticides. This macroeconomic policy change led to insufficient pest control and to the build-up of important pest habitats within the cocoa-based plantations.

The development of farmer-based pest control strategies has evolved as a response to a growing demand for pesticides initially provided by the Government before the economic crisis of the early 1980s. During the pre-crisis era, farmers were

solely relying on subsidized pesticides and were not therefore concerned about alternatives to heavy pesticide use. Pesticide subsidies were high and were provided through a parastatal which has been set to supply agricultural inputs. Another parastatal controlled the cocoa market. In 1989, the cocoa sub-sector was badly hit by the overall economic crisis. Prices declined at international level and the Government had to undergo tough structural adjustment programs leading to the entire removal of input subsidies, and the liberation of cocoa products market.

These policies deeply affected the cocoa subsector. There were no accompanying political, legal and institutional incentives favoring the development of a dynamic private sector to take over the role played by the defunct parastatals. Cocoa production and the quality of the product decreased substantially.

The incentives to purchase appropriate levels of pesticides deteriorated again following the devaluation of the CFA Franc in 1994. This move effectively doubled the prices of imported inputs, although there were some increases in cocoa prices. To continue cocoa production at lower production costs, farmers embarked into developing some indigenous pest control practices based on their knowledge of pesticidal plants and the low level application of whatever synthetic pesticides were available to them.

This paper focuses on analyzing the shift *in* in the approaches to cocoa pest control and the nature of the alternatives adopted by the farmers. The particular interest of this paper is on farmers' knowledge of the botanical species used as extracts in the different botanical pesticides commonly used against black pod disease, capsids pests and other insect pests. An underlying thought is that this knowledge – although not examined quantitatively – should be made available to farmers managing other farming systems and to scientists elsewhere who are encouraged to study the value of these approaches. There may be lessons learned that will make it possible to rationalize pesticide application regimes where the application synthetic materials has become excessive. These findings will be the first step in the development of new IPM strategies in collaboration with biological scientists to meet the increasing demand of pest control by small cocoa producers *in* Cameroon and elsewhere.

Background

Study area

This study was carried out in the humid forest zone which includes both evergreen and deciduous rainforest. Cocoa production in Cameroon is dominated by small-holders farmers and is concentrated in the central and southern parts of the country, the major cocoa production zones. Cocoa is frequent in the forest agro-ecosystems because of its tolerance to shading. The traditional cocoa-based multi-strata agroforestry plantations are characterized by the combination of cocoa trees, fruit trees, non-fruit trees, and other vegetable and leguminous species like cocoyams, cassava, sweet potatoes. Food crops are usually associated in the agroforestry systems during the creation of the plantation and often disappear after some years leaving almost a mono-specific cocoa field (Tonye *et al.* 1987).

The area of study is divided into high and relatively low population density zones. Yaoundé in the Central region of the country is considered as a high population density zone with about 50–100 persons/km^2. Land shortage is increasing and fallow lengths are being shortened from 20 to almost less than four years (Weber 1977; Leplaideur 1985; Russel 1993). In the Mbalmayo area, the population density ranges from 13 to 25 inhabitants/km^2. The secondary forest is gradually disappearing with fallow periods varying from 5 to 10 years for mixed crop food fields. Land pressure has intensified as a result of population pressure but is less here than in the Yaoundé zone. The last tract is the Ebolowa zone which is situated within the rain forest of southern Cameroon with lower population density and less pressure for land.

Sampling Procedures and Surveys

A total of 301 cocoa farmers was sampled and interviewed individually in the three zones, in a total of 21 villages (7 villages in each zone). A pre-survey has been carried-out with key informants and focused group discussions to assess the trend and the main issues linked to cocoa production in the villages. The pre-survey was followed by a formal survey with thorough data collection

from farm household heads. Data collected include, socio-economic characteristics (age, marital status, level of education, family size, ethnicity, cocoa farming experience, number of cocoa fields, agricultural and non-agricultural sources of income, access to credit and contacts with extension). Information was also collected on pest incidence before and after the economic crisis, farmer's perceptions about pests and diseases and related crop losses. Farmer's pest control methods and dynamics were also covered. Particular attention was given to the application and prices of synthetic (insecticides, fungicides and herbicides).

This paper focuses more on farmers' knowledge of pests and indigenous pest control methods. Some problems faced in the study is that some farmers would not tell exactly some of the practices because of the use of law-forbidden plants like 'Banga' or 'Indian hemp' (*Cannabis sativa*) which are involved in the preparation of some locally made insecticides.

Key Issues in the Dynamics of Cocoa Sub-Sector in Cameroon

The majority of cocoa farms in Africa are small holdings. Since its introduction in Cameroon in 1886 (Santoir 1992 in Ndoye 1997), cocoa production has increased during the last 22 years peaking at 133,000 mt in 1988 (SODECAO 1995). The Government has been monitoring the cocoa sub-sector through a marketing board called 'Caisse de stabilisation des prix du cacao' or CSPC and used to set producer's price. The producer's price has been generally much lower than the FOB price (Free of Board). This implicit taxation was supposed to generate resources for funding non-cocoa development projects and/or subsidizing imported inputs (Assoumou 1977; Ndoye 1997). Cocoa production started to fluctuate in the mid-1980s stemming from several production constraints. The most able workers went to the cities to find better jobs, labor. There were high crop losses due to insects and diseases after the removal of input subsidies. The process of plantation renewal was neglected. However, the critical factor is that the decline in prices, following the international economic crisis in the 1980s (Table 1), which makes farmers less inclined to harvest their pods and replant when needed.

The first major crisis struck the cocoa sub-sector in 1985. As in other producing countries in Africa (Côte d'Ivoire, Ghana, Nigeria) the Cameroon Government provided little support to cocoa producers (Losch *et al.* 1991; Ruf 1993). The abrupt removal of subsidies on imported fertilizers, and pesticides, the dismantlement of the parastatals that fixed prices and supplied the subsidized inputs, and the extension services had a drastic impact on this sector of the farming community. This was compounded by the exposure of this sector to the cost of inputs on the world market. Farmers were not probably ready for such policy shifts and the Government did not prepare the legal and infrastructural ground for a smooth take-over by the private sector. The devaluation of the CFA Franc in 1994 did increase output prices but also doubled imported input prices. The net effects although not well documented were not enough to boost the incentives for a very responsive supply shift of the production. Small farmers started diversifying their sources of income by introducing new activities within the cropping systems within and outside the cocoa agro-ecosystems. Losch *et al.* (1991) studied farmer's adaptive strategies just after the crisis in Cameroon, and found that cocoa farmers adapted to the crisis by reducing production and living costs. Family members replaced hired labor and the areas under cocoa were reduced. At the household level, savings were made by cutting expenditures on healthcare and child education, and especially of girls.

Results

Farmers' characteristics and perception of pest incidence

The survey found that most of the farmers across the three zones have a basic education with 46% and 45% of farmers in the sample having primary and secondary education levels respectively. Most of them could easily read labels in French, which made pesticide identification much easier and some farmers had kept empty pesticide containers used years ago. An old farmer has been keeping 50 l of an insecticide – *Gamophel* – supplied

20 years ago. When asked about the contact with cocoa extension agents, the majority (65%) of farmers had contact with extension agents before the cocoa in 1989, those who did not have contact with agents where old household heads and young migrants who left the cities for the rural areas in the early 1990s when the Government extension system were phased-out.

With respect to the importance of cocoa plantations in the farming systems as a whole, they are still important and each household had at least two plantation fields, this corroborates other findings in the same location (Gockowski *et al.* 1998). The latest survey found that cocoa plantations cover the largest part of available agricultural lands. The survey results show also that farmers had long experience in cocoa farming. One farmer has been cultivating cocoa for 66 years. The average experience in the cocoa farming is about 21 years. Beside the role of cocoa as the major cash crop, plantations are the traditional claim for land ownership in this region of Cameroon. Most of the plantations are inherited and transferred to heirs through family ties.

Farmers' knowledge and ranking of major production constraints revealed that insects, diseases and weeds are reported as the most important, in that order. Capsids are perceived as the first most important insect pest within cocoa agro-ecosystems as reported by 67% of farmers. The common explanation given is the increase in this pest population following the stop of mass fumigation, formerly the role of the Government. Black Pod disease has been reported as the most important disease in the cocoa production in Cameroon (Ruf 1993). Black Pod disease was initially controlled by cheap fungicides subsidized by the Government.

The use of phytosanitary products within cocoa agro-ecosystems was investigated and the results show a substantial decrease in the use after the cocoa price shock in 1989. In fact, the difference between the use of pesticides 'before the crisis' and 'during the crisis' is clear (significant at 1%), revealing a strong negative correlation between the crisis and the use of phytosanitary products. Table 2 illustrates the trend in the use of phytosanitary products during the three periods. Most of the farmers (71%) acknowledged a marked change in the approach to pest management be-

Table 1. Dynamics of Cocoa prices in Cameroon

Year	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Price	120	130	150	220	260	290	300	310	330	370	410	420	420	420	420	250	250	200	150	300	450	340

Adapted from ONCC (Office Nationale de Commercialisation du Cacao).

Table 2. Use of phytosanitary products (chemical pesticides) in Cocoa agro-ecosystems: in three economic periods

	Before the crisis	During the crisis	After devaluation
High rate of application of synthetic pesticides	71	2	6
Moderate rate of application of synthetic pesticides	19	27	30
Low rate of application of synthetic pesticides	3	44	31
Synthetic products not applied	6	27	33
Total	100	100	100
Significance level		A*	b**

Note: A – Significance level between 'Before the crisis' and 'During the crisis'; b – Significance level between 'During the crisis' and 'After devaluation'; * = Significant at 1% Pearson χ^2; ** = Significant at 5%; NS = Not significant.

fore and after the crisis, compared to only 2% who reported no change in the use of pesticides during the crisis period. The devaluation did not affect these patterns, as the farmer's pesticide decision is based on the net effects of the increase in both input and output prices instead of the increase in nominal prices of pesticides only.

New pest controlled methods based on indigenous knowledge

As adaptative measures to lower the impact of the economic crisis by cost cutting, farmers developed different practices of pest control mainly based on plant extracts. The species most often encountered is hemp (*Cannabis sativa*) (Table 3). This is an exotic herb which produces a toxic substance consumed as soft drug. Among the several species of hemp, the common one in Cameroon is Indian hemp. The plant is commonly called 'Chanvre indien' or 'banga' in local language.

Farmers exploit extracts of this plant as pesticide in different ways. The plant extract can be combined with synthetic products or with other indigenous plant extracts at different concentrations or mixture doses. The plant leaves can be boiled, dried or pounded to extract the active ingredients. Farmers reported that planting the hemp in the cocoa plantations can be a deterrent to insects by itself. They also believe that hemp can control several kinds of cocoa pests, black pod disease and capsids.

Women farmers have traditionally applied hemp extracts for the control of pests of food crop (groundnut and maize) fields. They report that the plant extract can control nematodes and other soil pests.

Table 3. Indigenous pest control practices based on *Cannabis sativa*

Some major traditional practices	Method	Pests controlled	% of users (n = 301)
Fresh leaves of Banga (*Cannabis sativa*) boiled and left to stand for weeks, mix 6cl of the product with 15 l of water, then spray	Botanical	BPD, capsids	16
Fresh leaves of Banga mixed with tobacco (*Nicotiana tabacum*) leaves boiled together, then ferment as long as possible and spray on attacked plants	Botanical	BPD, all kind of insect pests	2
Fresh leaves of Banga boiled and left to stand for weeks, mix with 1 sachet of any available chemical fungicide in 15 l of water, then spray	Botanical and Chemical	BPD, all kind of insect pests	10
Banga leaves mixed with Essingang (*Guibourtia tessmannii*), elon (*Erythrophleum ivorense*) and [Doum (*Ceiba pentandra*) or tobacco or Eyeck (*Pachyelasma tessmannii*) barks] and boiled together, fermented and stand for some days. Take 6cl of the product mix with 15 l of water and spray	Botanical	BPD	3

Source: Survey data, 1997.
Note: Percent cannot add up to 100%, because of multiple responses. Percents are lower than the reality of the facts as majority of cocoa farmers feared to answer questions related to the use of a law abide herb.

Table 4. Other Indigenous techniques not including *Cannabis sativa*

Some major traditional Practices	Method	Pests controlled	% of users (n = 301)
1. Elon (*Enythnophleum ivorense*), barks boiled and stand for days then used 6cl with 15 l of water	Botanical	BPD	2
2. Elon (*Enythnophleum ivorense*), barks boiled and stand for days then used 6cl with 15 l of water And a sachet of any available fungicide	Botanical and Chemical	BPD	2
3. Paw–paw leaves (*Carica papaya*) stirred in water left to stand and spray	Botanical	All type of insects	3
4. Tobacco (*Nicotina tabacum*) leaves stirred in water and left to stand, then spray	Botanical	Insect pests	4

Source: Survey data, 1997.
Note: Percent cannot add up to 100%, because of multiple responses. Percents are lower than the reality of the facts as majority of cocoa farmers feared to answer questions related to the use of a law abide herb.

The sustainability of the adoption of banga plant extracts as an insecticide is however threatened as the plant is officially forbidden for cropping because of its classification as drug. Farmers would usually hide the use of the plant as insecticide and would crop it far in the forest or within the deep plantation. The common use of this plant extract to control cocoa pests is recent.

Among the other local plant species commonly used are *Erythrophleum ivorense*, *Guibourtia tessmannii*, and *Nicotiana tabacum* (Table 4). The extracts of these species are used alone or mixed with other plant extracts and/or fungicides. Extracts are collected from barks, roots and any other part of the plant. According to farmers the effectiveness of the extracts depends on the number of species used. Diversified species mixtures are supposed to be more effective. Farmers are knowledgeable about the toxicity of the different species they use. They reported the high human toxicity of species like *Erythrophleum ivorense*. Others, such as essingang (*Guiboutia tessmannii*) and banga are not considered toxic when boiled and are commonly taken as medicines for malaria, stomachache, and headache etc.

Other common cost saving pest control techniques are the mixtures of plant extracts with chemical pesticides (Tables 5 and 6). The objective of farmers is to cut costs while maintaining a minimum of effectiveness of the pesticide. Farmers report that with these mixtures and integrated botanical and chemical pest control, they can cut down in the number of sprays per season from eight to four. Except for banga, the other plant-based pesticide species are found within the cocoa plantations, thus making them accessible. Farmers also reveal that they do not apply their pesticides according to a predetermined threshold density. They apply when the whole plantation or part of the plantation is attacked. Farmers claim to have

Table 5. Some plant species used in indigenous pest control strategies in the humid forest zone of Cameroon following the cocoa crisis

Common or indigenous name	Scientific name	Family	Type and use status	Part of the plant used
1. Banga or Chanvre Indien	*Cannabis sativa*	Cannabinaceae(H)	A – MB & MC	Leaves; grains
2. Tobacco	*Nicotiana tabacum*	Solanaceae (H)	A – MB	Leaves
3. Essingang	*Guibourtia tessmannii*	Caesalpiniaceae (T)	M – MB & MC	Bark
4. Elon	*Erythrophleum ivorense*	Caesalpiniaceae (T)	A – MB & MC	Bark
5. Doum	*Ceiba pentandra*	Bombacacées (T)	A – MB	Bark
6. Eyeck	*Pachyelasma tessmannii*	Caesalpiniaceae (T)	M – MB	Bark
7. Pawpaw (Papayer)	*Carica papaya*	Caricaceae (T)	A	Leaves

Sources: Data survey, 1997.
Note: T – Tree; H – Herb; M – Always mixed with other substance(s); A – Can be use alone, mixed with water; MB – Usually mixed with other botanical species; MC – Usually mixed with chemical pesticides.

Table 6. Chemical pesticides usually mixed with botanical pesticides in the humid forest zone of Cameroon

Pesticide name	Active ingredient	Observations
Ridomil plus fungicide	Metalaxyl (12%) + Cuprous oxide (60%)	Penetrating fungicide, the most preferred by cocoa farmers, when used alone
Nordox plus fungicide	Cuprous oxide (75%)	Contact fungicide
Caocobre fungicide	Cuprous oxide (50%)	Contact fungicide
Kocide fungicide	Cuprous hydroxide (50%)	Contact fungicide
Hydrox fungicide	Cuprous hydroxide (50%)	Contact fungicide
Perenox fungicide	Cuprous oxide (50%)	Contact fungicide
Dursban 4 EC insecticide	Chlorpyrifosethyl (240 g/l)	
Methyl paraffin insecticide		The most used pesticide after the cocoa crisis, particularly by cocoa farmers and lowland farmers on legumes
DDT insecticide		
Thimul insecticide	Endosulfan	

Sources: Survey data, 1997 and IRAD, 1993.

Table 7. Selection of locally available species used for pest control in sub-Saharan countries

Plant	Country	Utilisation	Pests controlled
Chili pepper (*Capsicum frutescens*)	Kenya	Stirred in water, left to stand and spray	Aphids and diarrhoea for chickens
Custard apple sweets op (*Annoma* sp.)	West Africa	Water suspension of seeds	Insects pest
Neem (*Azardirachta indica*)	Various location	Dried, sprayed roots add to stored products	Weevils
Mexican marigold	Kenya	Cut and laid around livestock	repel safari ants
Simson weeds (*Datura stratonium*)	Cameroon	Leaves, stems, flowers and seeds shredded and soaked in water, soap and kerosene solution	Leaf caterpillar and aphids
Castor oil (*Ricinus communis*)	Cameroon	Seeds mashed and heated in water, soap and kerosene solution mixture sifted, diluted and sprayed.	

Source: Pretty, 1995, pp. 102

a clear idea about the threshold above which insecticide application will not be cost effective. According to farmers, the most important advantage of the combined botanical and chemical controls to control many pests at the same time. Despite the recognized effectiveness of some plant extracts, they indicated that they would prefer chemical control if the prices were subsidized or if they had access to credit at a reasonable interest rate.

Some other relatively cheap chemicals are also used in combination of the plant extracts (e.g., informal insecticides include kerosene, Crezyl (a sanitary cleaning product), *kanfa* or naphthalene (a cockroach insecticide use for clothing, powder from burned old tyres). Farmers perceive them as dangerous for cocoa fruit and leaves, but use them because of lack of other alternatives (Table 7).

Conclusion

This study reports how pest control strategies developed by cocoa farmers have replaced conventional practices in responses to economic and cocoa crises since 1989. Most of the practices involve the use of *Cannabis sativa* and other plant extracts. Notwithstanding some limitation, the study shows how farmers have adapted themselves to low cost plant protection techniques based on indigenous knowledge and practices. These practices are often combined with chemical pesticides

at different doses and types of combinations. Farmers also recognized the fact that alternative methods are used to save chemical pesticides costs. This study has four principal recommendations: – Scientists from agricultural research should tap on some of these indigenous knowledge of plant extracts and farmers' knowledge of botanical insecticide to build appropriate and low cost integrated pest management strategies. Research should be carried-out on the active matter of these species for future industrial use as substitutes to imported pesticides. The use of plant extracts by farmers should be encouraged as the costs to environment are low, further studies should be carried on to investigate these matters. A strong collaboration between scientists, farmers and interested NGOs through participatory research should be encouraged for environmentally sound and cost effective IPM technology development.

Acknowledgements

Authors are grateful to Joseph Mve Mve who entered the data. Appreciation is also due to Dr. M. Tchatat from IRAD, Dominique Endamana, and Aloys Nnama for their useful contribution during field work and specially Dr. L. Zapfack for the determination of species.

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