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EFFECTIVE MANAGEMENT OF COCOA FARMS IN NIGERIA FOR PROFITABILITY

A.A.Adeyemi [2]

INTRODUCTION

Cocoa (*Theobroma cacao*) has very high yield potential. Yield as high as 200 pods per tree per annum has been recorded from some F3 Amazon selections in Nigeria (Atanda, 1971; Jacob and Olaniran, 1971). This figure, using Are et. al. (1971) conversion ratio of 24 pods to 1 kg dry beans gives about 8 tonnes per hectare of dry beans. In Ghana, Glendinning (1962) also investigating the yield of cocoa reported that a dry bean yield up to about 3.3 tonnes per hectare was realised from some Trinidad introductions. In spite of this good characteristics of cocoa even when the soil is suitable, as described by Smyth and Montgomery (1962), Smith (1966), Egbe and Omotoso (1971) and Egbe et. al. (1989), effective management of the farm must still be carried out before good yield can be realised. Lack of proper maintenance of cocoa farms has always resulted in etiolation and poor general performance of cocoa trees leading to high incidence of pests and diseases and low yield. This paper attempts to review the current management practices in cocoa in Nigeria that can lead to high yield and thus make the agricultural venture a profitable and more sustainable one.

ROUTINE MAINTENANCE OF COCOA FARMS

Optimum environmental and edaphic factors (air/oxygen, light, moisture, soil nutrients) as needed for proper growth and yield of cocoa and to reduce incidence of pests and diseases on cocoa farms in Nigeria are needed. Mulching, shade management, weed control, pruning, control of epiphytes and parasites and the establishment of fire traces are the crop husbandry practices recommended for the effective routine maintenance of cocoa farms in Nigeria (Are et. al., 1971; Odegbaro, 1977; Adeyemi, 1992b, 1992c, 1993a; Adeyemi et. al., 1992).

Mulching

Mulching is a cultural practice carried out in the early years of cocoa establishment to conserve moisture in the soil during the dry season (November to March). Mulch acts as shade, protecting the soil surface from direct sunlight and is important in the establishment, growth and yield of cocoa in Nigeria (Egbe and Omotoso, 1971; Omotoso, 1973). Dry plantain/banana leaves, grasses and other leafy plant organs are used. The mulch, about 7.5 to 15.0cm thick, is arranged in circular form around the individual cocoa trees ensuring clearance of about 7.5cm radius between the edge of the mulch and the cocoa tree to prevent termite infestation. In addition to soil moisture preservation, mulch can also serve as organic fertiliser after decomposition.

Shade Management

In Nigeria, cocoa requires shade only in the early establishment years (3 to 4 years after planting), when the root system has not fully developed and the tree is unable to tap moisture from any depth of soil. Provision of temporary shade, either natural or planted, reduces water

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loss of from the leaves as well as from the soil surface during the dry period. Young cocoa trees in Nigeria have stunted growth, chlorotic leaves and poor survival rates when grown under no shade conditions (Longworth, 1963; Are et. al., 1971).

Plantain, banana, tree cassava, pawpaw and palm fronds can be used as temporary shade in cocoa but plantain is preferred. It is relatively cheap to establish, does not compete with cocoa for nutrients and water and is very economical, while serving as a source of income to farmers until the cocoa trees come in to bearing. Plantain at 3m x 3m or one plant per cocoa tree, gives a population of 1,111 plantain trees per hectare. Because of its high rate of multiplication, the population can be as high as five times the initial number, if the suckers are not efficiently and regularly managed. Two young suckers on each adult plantain should be retained to replace the adult plantain after harvest, thus avoiding over-shading. Ideally, plantains should be planted a year before the cocoa, but most often it is planted in the same year as the cocoa. Where the two crops are planted in the same year, plantain is established with the early rains in March/April to allow the plantain to form some shade before cocoa is transplanted to the field in June/July. The population of plantain diminishes with the age of the farm and about 5 to 8 years after planting, it may have almost disappeared due to natural shading (Adeyemi, 1991b).

Where the farm has been initially established through selective thinning of forest, reduction of the forest shade is done gradually by killing the trees with tree killers or by girdling, to prevent over-shading and high incidence of diseases that could occur from the high humidity conditions of the farm. Improved aeration from the reduction of shade leads to increased yield of cocoa. Increased light intensity increases yield, as dry matter accumulation in cocoa leaves increases as the light intensity increases (Omotoso, 1973). Shade is not necessary for mature cocoa under Nigerian conditions, as the roots are well developed and are capable of exploring deeper zones of soil for moisture and nutrients and the canopy at this stage is closed enough to provide adequate shade to minimise moisture loss form the soil.

Weed Control

Weeds are one of the greatest biological problems of cocoa farms in Nigeria. They compete with cocoa for water and nutrients thus hindering its growth, performance and yield. In some cases the young seedlings are completely smothered by weeds, resulting in poor establishment and they also serve as reservoirs for diseases and pests, including squirrels and rodents that devour cocoa pods. Weed infestation is a more serious problem in young cocoa with unclosed canopy during the first 3 to 5 years of establishment, than in mature cocoa with closed canopy. The complete canopy suppresses weed growth, though weeds are a problem in mature cocoa where the canopy is damaged due to leaf abscission (tree defoliation) in senescent cocoa, or when trees are missing due to death, poor establishment or dieback caused by mirids. Weeds can also be a problem where the weed species are shade tolerant such as with *Axonopus compressus*, *Cynthula prostata*, *Asystasia gigantica* which can even grow under a heavy cocoa canopy (Adeyemi, 1991b, 1992a).

Several weed species are important in cocoa farms in Nigeria (Komolafe, 1976; Oladokun and Utulu, 1988; Adeyemi, 1988b, 1992a). They include the species above and *Panicum spp.*, *Setaria spp.*, *Chromolaena odorata*, *Ageratum conyzoides*, *Acalypha ciliata*, *Euphorbia spp.*, *Fluerya aestuans*, *Pouzolzia guineensis*, *Amaranthus spinosus* and *Sida spp.* Weeds are controlled by manual, cultural methods or with chemicals or a combination of these.

Manual Weed Control

Manual weed control is effected by slashing the weeds with sharp strong cutlass. It is initially effective but weed re-growth is very fast, necessitating about 3 to 6 rounds of weeding per annum depending on the ecology and the type of weeds of the area (Adeyemi, 1984a, 1986a, 1992a; Adeyemi and Adenikinju, 1984). Weeds are not removed from the farm but are left as organic mulch to decompose. Hoeing is not encouraged in cocoa farms because of the damage that may be done to the roots of cocoa.

Cultural Weed Control

Mulching of young cocoa farms (i.e. cocoa within 3 to 4 years of establishment) has been found to suppress weeds, conserve soil moisture and improve the vigour and yield of cocoa (Longworth, 1963; Are et. al., 1971). Intercropping is popular among peasant farmers of Nigeria especially in the South Western part of the country, using cassava, cocoyam, yam, maize, melon, okra and cowpea cultured with cocoa in different combinations. Cocoa/plantain/yam/maize/cowpea, cocoa/plantain/cassava/melon and cocoa/plantain/cocoyam/okra/melon intercrops have been proved to cause no harm to the cocoa and are also effective in reducing weed incidence (Adeyemi, 1983, 1984a, 1986b, 1988c, 1989). The number of weeding rounds is lower in intercopped plots than when cocoa is grown in pure stands (Adeyemi, 1988b). Maize and cowpea have also been successfully intercropped in rehabilitation plots (Adeyemi, 1984b).

Chemical Weed Control

Initially, only paraquat (at 0.60 kg a.i/ha) was recommended for effective weed control (Freeman and Ashiru, 1966). Recent work has shown that weeds can be effectively controlled by Gramuron (Paraquat and diuron) at 2.0 kg a.i/ha, by glyphosate (1.92 kg/ha) and by tank mixture of Asulam plus Actril DS (ioxynil +2, 4-D) at 3.40 + 1.05 kg/ha (Adeyemi and Adenikinju, 1984, 1988a, 1991a, 1992a). Each of the herbicide rates is diluted with water at the rate of 300 litres per hectare and applied with 4-Oak knapsack sprayer at the pressure of 5.45 kg/cm^2. These rates are further simplified to 90, 150, 120 and 255 + 75 ml of paraquat, Gramuron, glyphosate and asulam + Actril DS respectively in 9 litres of water for farmers whose farm is less than one hectare. Although the four herbicide formulations are effective in controlling weeds in cocoa, the weed re-growth period in paraquat treated plots is significantly shorter than that of other herbicides (Adeyemi, 1988a). This implies that paraquat has no lasting effect on weeds. No phytotoxicity has been observed on cocoa either young or mature after careful application of these herbicides (Adeyemi, 1991a, 1993b). Paraquat was the most popular herbicide due to its relative cheapness and immediate apparent action on weeds (Adeyemi, 1984c).

Pruning

Pruning is a routine practice in cocoa and carried out to control the height, to give the desired shape and to ventilate farms to reduce disease and pest incidence. All unnecessary branches including chupons, excessive and dry fan-branches are removed with sharp cutlasses, secateurs, pruning saws and shears. To allow for easy operational movements in the farm, jorquetting of cocoa trees from 1.2m upwards is encouraged. Where this occurs

at lower height, branches are removed by pruning which allows further growth of the main stem before the apical stem is removed to give fan-branches.

Light pruning is done any time of the year while heavy pruning is carried out during the rainy season (April to October). All cut surfaces should be painted with a wound dressing paint to prevent entry of rain and pathogens. Pruning is an accepted practice in Nigeria and the frequency of carrying out the operation depends on the age and the growth pattern of cocoa. One main pruning per annum is adequate but excess chupons may be removed 3 to 4 times in a year when cocoa growth is vigorous.

Control of Epiphytes and Parasites

Poorly maintained cocoa farms are often infested with parasites such as mistletoes (*Tapinanthus spp.* and *Euglerina gabonensis*) and epiphytes including bryophytes, liverworts, mosses and lichens. A high level of mistletoe infestation usually results in the degeneration of cocoa trees and high yield loss, because they are parasitic and compete with the host plant for food and nutrients. Epiphytes even though they do not derive their food from their hosts also cover the trunks of cocoa including the flower cushions with their flat or mat-like bodies leading to inhibition of flower production and perhaps enhanced levels of pod attack by *Phytophthora spp.* as they raise the humidity levels. Mistletoes in Nigeria are best controlled by physical removal with sharp tools such as cutlasses, axes and pruning shears (if available). Effective control is achieved when the removal is done at the time of the flowering of the parasites. Epiphytes on the other hand are controlled culturally through prompt removal of unwanted chupons, fan-branches and excess overhead shade. This improves the ventilation and reduces the damping-off condition in the farms.

Fire Trace

Cleared paths of minimum width of three metres should be constructed round the farm to forestall the spread of any bush fire during the dry season. Entry of animal pests into the plantations is also reduced by these paths and so it is useful to keep them cleared throughout the year.

Soil Fertility Maintenance in Cocoa Farms

Under normal conditions, cocoa grown on good soil in Nigeria does not need any nutrient supplementation at the juvenile state (Egbe and Omotoso, 1971; Omotoso, 1973). The available nutrients in suitable cocoa soils are enough to support good growth and yield of cocoa up to 12/20 years for Amazon cocoa and longer than this for Amelonado (Omotoso, 1975; Ojeniyi, 1981). Nitrogen and phosphorus have been shown to be essential for the increased yield of cocoa at the mature stage while significant response has not been shown to K application. Consequently high rates of N and P (337 g each of urea and single superphosphate) and a low rate of K (87 g KCL) per tree are applied to mature Amazon cocoa. For Amelonado cocoa, 275 g urea, 225 g SSP and 36 g KCL per tree are used for soil nutrient supplementation. When expressed in elemental forms the fertiliser requirements of cocoa may range from 120 to 240 kg N, 30 to 140 kg P and 58 to 67 kg K per hectare per annum depending on the age and type of cocoa. Application of about

6g of Boron per tree per annum would also result in increased yield of cocoa. For young cocoa grown on deficient forest soils only phosphorus in the form of single superphosphate at 135 to 270 g per cocoa tree needs to be applied to correct the nutrient imbalance.

DISEASES AND PESTS

Diseases

Phytophthora pod rot (black pod) disease is of real economic importance in Nigeria. Cocoa Swollen Shoot Virus (CSSV) is also present but scarcely causes an economic loss.

Black Pod (Phytophthora pod rot)

Two forms of the fungus - *P.palmivora* and *P.megakarya* have now been identified as the causal agents of black pod disease in Nigeria (Sansome et. al., 1975) contrary to the initial belief that the disease is caused by *P.palmivora* only (Gorenz and Okaisabor, 1971). Black pod is the most serious disease of cocoa in Nigeria causing an annual bean loss of about 30 to 35% (Gorenz and Okaisabor, 1971). Yield loss can range from 5% in the dry areas to 80% in the wet parts of the country (Odegbaro, 1977) depending on rainfall and relative humidity.

The pathogens can affect all cocoa plant parts, but it is of most marked effect on the pods. It is first observed as a brown spot or discoloration on the pod. The spot spread rapidly under favourable conditions covering the pod surface within a week or two of its first appearance. In the course of infection, white patches of fungal hyphae coupled with masses of sporangia are formed on the lesions. At the advanced stage of infection, the pathogen penetrates into the centre of the pod and renders the seeds useless (Gorenz and Okaisabor, 1971). The main vehicle of infection is rain splash followed by insect, air currents and vertebrate pests while the sources of inoculum are soil, flower cushions, dry pods from the previous season either on the cocoa trees or on the ground and debris formed from heaping of cocoa pod husks from previous harvests.

The disease is controlled through cultural practices such as farm sanitation through weeding, pruning of chupons and unwanted fan-branches and prompt removal of shade as earlier described to improve the ventilation of the farm and consequently reduce the relative humidity. Application of copper-based fungicides (Bordeaux mixture, Perenox, Kocide 101 and Copper Nordox) at three weekly intervals commencing from the onset of the rains is effective in controlling black pod disease of cocoa in Nigeria. Their active ingredients and rates are given in Table 1.

However, a new fungicide - Ridomil plus 52 W.P. whose active ingredients are cuprous oxide and metalaxyl is presently being studied. In general, the effectiveness of all the fungicides are influenced by the variety of cocoa and location in terms of its climatic conditions (Adegbola and Filani, 1985; Adegbola, 1986). Research in Nigeria to produce resistant/tolerant and escape varieties of cocoa that would be able to resist and avoid the disease respectively is underway.

Table 1. The Composition and Rate of Application of Some Fungicides used in Controlling Black Pod Disease in Nigeria

Trade Name	Common Name / Active Ingredient	Rate (g/9 litres of water)
Lime Bordeaux mixture	Copper sulphate and lime	90.0 + 36.0
Perenox	Cuprous oxide	40.0
Kocide 101	Copper hydroxide	40.0
Copper Nordox	Cuprous oxide	45.0
Brestan	Triphenyltin acetate	13.3

Cocoa Swollen Shoot Virus (CSSV)

The disease is caused by the virus called Cocoa Swollen Shoot Virus (CSSV) and there are many strains of the CSSV in Nigeria named after the localities from where they were isolated (Thresh and Tinsley, 1959; Thresh, 1961). They include Ikire (Egbeda), Offa-Igbo, Ilaro, Abuku, Balogun, Alaparun, Olanla, Ilesa and Ife etc. The symptoms vary according to the strains but range from swellings on stems and roots to leaf chlorosis/necrosis (leaf vein clearing). The attack of CSSV can also lead to complete defoliation and dieback of cocoa trees in more virulent strains. The Ikire isolate is the most virulent though most Nigeria isolates only cause modest swellings (Adegbola, 1971). The Ikire isolate is implicated in the death of young seedlings. The disease is transmitted by mealybugs. Initially, it was controlled by prompt removal of all the cocoa trees around the point of infection up to the radius of 30m away but this has since been stopped due to the low virulence. CSSV is now at a low level with the replacement of the infected cocoa trees with tolerant/resistant varieties, either by complete farm replanting, planting of the improved varieties under the shade of old cocoa or through coppicing of the old cocoa trees. Removal of wild hosts through the reduction of specific shade trees where cocoa is grown under forest trees also assists in reducing the sources of inoculum and the incidence of the disease.

Insect Pests of Cocoa

Mirids (Capsids), are economically the most important pest though some damage is also caused by *Characoma stictigrapta, Earias biplaga* and the mealybugs (CSSV vectors) (Adeyemi et. al., 1992). Estimated annual losses due to the attack of cocoa by these insects vary between 2 and 25%.

Mirids

Sahlbergella singularis Hagl. (the light mirid), *Distantiella theobroma* Dist. (the dark brown mirid) and *Helopeltis* spp. (the "Cocoa mosquito") are the three major species of mirids in Nigeria. They are shoot feeders that feed mainly on the plant sap of cocoa through their piercing and sucking mouthparts. Damage from mirids are permanent wilting of growing points and leaf flushes, defoliation of leaves giving a staghead appearance to the cocoa trees and the eventual die-back of the trees. The dieback may be further aggravated by infection with a fungus - *Calonectria rigidiscula* whose entry is through the wounds created by the mirids. Yellowing and permanent wilting of cherelles and the appearance of punctures on the

surface of mature pods in mirid infested plantations can also cause losses. It is estimated that up to 15/25% of cocoa trees are lost annually to mirid infestation in Nigeria (Adeyemi et. al., 1992).

Mirid infestation in cocoa farms in Nigeria is reduced by cultural practices and chemical control. Cultural operations involve the pruning of infested branches, regular removal of chupons and infested young cocoa pods to deprive the mirids of suitable feeding and breeding sites. Good establishment of cocoa farms to form a closed canopy and preventing gaps (capsid pockets) through which mirids can enter the farm has always helped in minimising mirid infestation.

Mirid infestation in Nigeria has been historically controlled through the application of contact insecticides. These include Gammalin 20 E.C. and Unden 20 E.C. each applied at 113 mls in 9 litres of water, Mipcin 75 W.P., at 3.3 g a.i.litre of water, Dursban 4 E.C. at 48 mls per 9 litres of water and Elocron 75 and 50 W.P. applied at 0.25% concentration. They are applied with knapsack sprayers or motorised knapsack sprayers of the "Motoblo" type or with Swing-fog machines. Best results are obtained when the applications are done in August, September and October every year. But using an Integrated Pest Management (IPM) approach, it is advisable to only spray chemicals to control mirids when their number is at economic threshold so as to minimise the quantity of insecticides used (Idowu, 1993 *pers. comm.*). Biological control of mirids through the use of parasites such as braconidae and mamilionides is still under research in Nigeria. Alternative management systems for capsid control are needed.

Characoma stictigrapta

This is a moth with pod boring larvae that attacks the cocoa cherelles and pods (Ojo, 1980). Annual pod loss due to its attack varies between 10 and 15% (Adeyemi et. al., 1992). The insect, especially the larvae, which causes the damage to pods can be controlled by the application of Gammalin 20 E.C. and Elocron 50 E.P. at 0.25% concentration.

Earias biplaga

The insect is a moth and it is the larva, a spiny boll worm that causes damage to buds and young leaves of cocoa. It is very prevalent in young unshaded cocoa farms. The annual loss in Nigeria due to its infestation is about 5 to 10% (Adeyemi et. al., 1992). The cultural practices described for mirids can also effectively control this pest as can the application of insecticides.

Planococcoides njalensis

Cocoa mealybugs are very important in Nigeria especially in areas of high infection for Cocoa Swollen Shoot Virus disease (CSSV) because they act as the vectors of the disease. In addition, mealybugs also feed on plant sap, as do mirids. Effective control through chemical sprays is difficult to achieve since the mealybugs are protected by the waxy coverings. They can be controlled indirectly by controlling the ants with which each species is associated.

Table 2. Annual Cost of Maintaining One Hectare of a Mature Cocoa Farm in Nigeria

(a) Cost of Labour for the Maintenance Operations

Operations	Man-day	Unit Cost		Total Amount	
		N	$	N	$
Spraying against termites	3	60	2.93	180	8.78
Gapping up and shade management	8	60	2.93	480	23.41
Weeding	45	60	2.93	2,700	131.11
Removal of chupons, excessive and dead branches	5	60	2.93	300	14.63
Spraying against mirids	10	60	2.93	600	29.20
Application of fungicides	25	60	2.93	1,500	73.80
Harvesting and processing	45	60	2.93	2,700	131.00
Cutting of fire traces	5	60	2.93	300	14.63
Removal of mistletoes (parasites)	10.33	60	2.93	200	9.76
Total	**149.2**	—	—	**8,960**	**437.07**

(b) Cost of Inputs for the Maintenance Operations

Items of Inputs	Quantity Required	Unit Cost	Total Amount	
		N	N	$
Wheel barrows	2(1/5)	1,000	400	19.51
Aldrex 40 (litre)	2	100	200	9.76
Copper sulphate (kg)	30	65	1,950	9.51
Insecticide 20 (litre)	4.5	160	720	35.12
Hydrated lime (kg)	15	35	525	25.61
Fertiliser N P K (15-15-15) kg	400	1.6	640	31.22
Cutlasses	2(1/2)	85	85	4.14
CP3 Spraying pump	1/5	1,500	300	14.65
Water drum	1/5	350	70	3.41
Strainer	(2)1/5	10	4	0.20
Pair of gloves	2(1/5)	50	20	0.98
Apron/overall coat	2(1/3)	110	73	3.58
Iron file	1(1/3)	30	10	0.49
Water (litre)	500	0.1	50	2.44
Baskets	510	5	25	1.22
Harvesting knife	(4)1/5	10	8	0.40
Fermenting trays	(5)1/5	75	75	3.66
Plastic bucket	5	10	50	2.445
Drying slab	1/10	7,000	700	34.15
Incidental expenses			5,000	243.90
Total	—	—	**10,905**	**446.40**

Termites

These are important group of insects commonly found in newly established cocoa farms in Nigeria. They feed on the roots and barks of young cocoa trees. They are controlled culturally by intercropping young cocoa with dense-canopy, farming arable crops such as cocoyam and cassava that form additional shade and also act as baffles to the insects (Idowu, 1993). Application of Aldrex 40 E.C. at 1% concentration to the soil around an attacked cocoa tree is very effective in controlling termites in cocoa farms.

PROFITABILITY OF COCOA PRODUCTION IN NIGERIA

With the yield potentials of cocoa given at 4 to 8 tonnes per annum, actual yield of up to 2.0/2.5 tonnes can be expected when all the maintenance operations and pest control measures as described in this paper are effectively carried out and weather is favourable. Under the present economic situation in the country, cost of such operations in terms of labour and material inputs is as high as N18,110 or $883.47 (Table 2). The revenue from the farms under the present management practices based on the given yield is however, N40,000 to 50,000 per hectare. Consequently, a net annual profit range of about N21,889.67 to 31,889.67 ($1,951.22 to 2,439.02) per hectare can be realised by the farmer. In economic terms when the cash flow of the project in consideration to cost and income (benefit) are compared, a benefit/cost ratio (BCR) of 2.21 to 2.76 (Table 3) is obtained indicating that the agricultural venture is profitable.

Table 3. Cost/benefit Analysis from the Cash Flow on the Maintenance, Harvesting Fermentation and Drying of Cocoa in Nigeria

Variables	t/ha	Rate	Revenue		BCR
		N	N	$	
Yield	2.0-2.5	20,000	40,000-N50,000	1,951-$2,439	—
Total Cost of Production			18,110.33		
Benefit/Cost Ratio (B.C.R.)			—	—	2.21-2.76

One can therefore assume that the cultivation of cocoa in a humid tropical environment like that of Nigeria can be very profitable, if all the necessary components of improved production technologies are harnessed.

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REFLECTIONS ON THE YIELD OF UPPER AMAZON COCOA HYBRIDS IN GHANA WITH REFERENCE TO BREEDING FOR COCOA SWOLLEN SHOOT VIRUS RESISTANT VARIETIES

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INTRODUCTION

When cocoa research begun in Ghana in the mid-thirties it soon became apparent that the limited locally available germplasm would not permit a successful breeding programme. The germplasm available appeared to have been derived from a restricted area of the Amazon, so that there was very little genetic variation. The primary object of introducing Pound's Upper Amazon cocoa collections to West Africa (Posnette, 1948) was, therefore, to have available a greater genetic variability for breeding programmes.

Cocoa hybrids based on the Pound's (1940) Upper Amazon collections have been the basis of cocoa improvement in many countries ever since Posnette (1948) first observed heterosis in crosses involving them. This Upper Amazon material has also proved to be a rich source of disease resistance. In Ghana, a measure of resistance to infection with Cocoa Swollen Shoot Virus (CSSV) was observed in Upper Amazon material by Posnette and Todd (1951). The general observation was that Pound's Iquitos Mixed Calabacillo (IMC) and Nanay (NA) populations were the best sources of CSSV resistance (Attafuah and Glendinning, 1965; Glendinning et. al., 1966; Legg and Kenten, 1971a; Legg and Kenten, 1971b; Legg and Lockwood, 1977).

The significance of the discovery of a lethal virus disease of cocoa in Ghana in 1936 became fully appreciated in the 1940s (Posnette, 1947, Voelcker, 1948) and because of the enormous scale which the disease had reached, particularly in the Eastern Region, urgent attention and immediate solution to the problem became necessary. A great deal of work has been done on all aspects of cocoa cultivation at various times but the swollen shoot disease and its control has dominated research activities at CRIG until recently. One of the solutions to the CSSV problem was to breed for varieties resistant to the virus. It has long been apparent that successful hybrids with considerable resistance to infection could be produced by inter-crossing selected Upper Amazon parents. The problem has been how to produce suitably resistant hybrids that combine heterosis with many other attributes required if they were to perform better than the hybrids already being used (Thresh et. al., 1988).

The minimum period for producing entirely new hybrids was estimated to be about 12 years. To expedite progress, a breeding strategy was adopted to identify pollen parents, which, when crossed with the Upper Amazon female parents in the already established seed gardens in the Eastern Region, would give hybrids with higher levels of CSSV resistance and higher yield with at least the same levels of other agronomic and quality characteristics as the hybrids already being produced.

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