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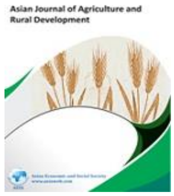

MANAGEMENT OF COCOA BLACK POD DISEASE BY FARMERS IN EDO STATE, NIGERIA: THE ROLE OF FARMER FIELD SCHOOL

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ABSTRACT

The specific objectives of the study were to find the contribution of FFS training in control of the disease; examine the role of FFS in improving farmers' competency in management of black pod disease, and determine the proportion of farmers that benefited from FFS training on management of black pod disease. A multi-stage sampling procedure was employed in selecting 76 FFS farmers and 74 other farmers, and various descriptive statistics and t-tests were used to analyze data. The results showed that FFS played a major role in improving FFS farmers' competency in the management of black pod disease. The t-tests conducted showed significant differences in knowledge between FFS farmers and other farmers.

Contribution/ Originality

The paper examined the role of farmer field school extension method play in boosting farmers' knowledge of disease control in Delta State, Nigeria. The study showed that FFS extension approach had led to the improved knowledge of cocoa farmers in managing black pod disease. Thus FFS training was recommended to be extended to other farmers besides cocoa farmers.

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1. INTRODUCTION

Cocoa (Theobroma cacao) is vulnerable to the attack of several diseases which could lead to considerable economic loss to farmers. Black pod disease causes the principal damage to cocoa pods the world over (Oduro *et al.*, 2020). Four species of the pathogens belonging to the genus Phytophthora cause black pod disease, but only two (*Phytophthora palmivora* and *Phytophthora megakarya*) are of economic relevance. These pathogens originally identified as fungi have now been regrouped into the Stramenopila kingdom of plants (Vanegtern *et al.*, 2015). The pathogens also result in cocoa developing canker. An acute attack of cocoa can result in absolute rot of pods; damages of pods may be as high as 50% or even higher (David, 2008). Severe infestation of cocoa pods can lead to almost 100% loss of pods (Pokou *et al.*, 2008; Adeniyi, 2019).

Besides pods, cocoa stem, flower cushions, and chupons could also be infected. In this situation, the disease causes tree canker, flower cushions may fall off and affected branches or chupons may wilt and die, eventually leading to the death of the whole tree. The black pod is therefore one of the most serious limitations to cocoa production (Adeniyi and Ogunsola, 2014; Simo *et al.*, 2014; Kudjordjie, 2015). As a result, Vanegtern *et al.* (2015) asserted that the output of the cocoa tree is far below its high yield potential.

Despite the damages caused by black pod disease, most cocoa farmers have difficulty in combating the menace of the fungi causing the disease. Recently, several development agencies like the World Bank and FAO have supported Farmer Field Schools (FFS) as a more successful approach to diffuse science-based knowledge and management practices (Asiaka, 2003; Adisa and Adeloye, 2012). According to David *et al.* (2006), the FFS extension approach has helped farmers elsewhere to lessen the incidence of damage caused by black pod disease on their farms. How successful the approach is in Edo state is worth considering.

A major challenge confronting agricultural extension in the present era is how to develop sustainable approaches that expand beyond disseminating technical information to farmers, to performing a key role in assisting peasant farmers manage themselves in such a way as to enhance farmer empowerment. Farmer field school (FFS) advance is usually seen as one approach that can meet this goal. FFSs were first established in Asia towards the end of the 1980s and have since been extended to Africa in the 1990s, covering different topics like integrated production and pest management (IPPM), soil management, livestock production, and other diverse topics (Braun *et al.*, 2006).

The disease has been defined in a number of ways but is generally referred to as an aberration in the physiology and anatomy of a living organism (Akinsanmi, 1980). The disease is a major cause of losses in crop production (Akaza *et al.*, 2016) Agricultural diseases may be caused by several agents (called pathogens) which included bacteria, viruses, protozoans, nematodes, or nutritional deficiency (Omoruyi *et al.*, 1999).

Pathogens have a negative impact on the value of the infected hosts (D'Arcy *et al.*, 2001; Anderson *et al.*, 2004). As a result, pathogens are significant environmental agents that may affect the composition of crop populations (Gilbert, 2002; Pagán *et al.*, 2016) and in extreme cases, cause the local extinction of host species (Alexander *et al.*, 2014). Also, pathogens are responsible for a substantial reduction in the yield of crops. The estimated annual losses in crop production (yield, quality, aesthetic value, etc.) worldwide has been put at between 13% and 16% (Oerke, 2006; Vurro *et al.*, 2010). The FAO estimated that indirect losses (effect, rural communities, environment, etc.) may be up to 20–40% (FAO, 2015), with the resultant economic and social impacts (Oerke, 2006; Vurro *et al.*, 2010).

Diseases of crops have caused serious losses to farmers in many ways (Maloy, 2005). Famine and displacing of families occurred in the Irish nation as a result of potato late blight, American corn growers suffered direct economic losses in a particular year from the attack of southern corn leaf blight. Thus diseases may collectively lead to colossal losses of farmers' crops by reducing the quantity and quality of crops (Maloy, 2005).

Several kinds of crops' pathogenic diseases affect various parts of crops, ranging from the root to the crown of the tree or crops. According to Agrawal (2018), these diseases affect cultivated crops as well as many kinds of wild plants. Each kind of crop plants can be affected by the from few to several thousand types of the plant pathogens. Plant diseases have been grouped in many ways like based on the symptoms spots, blights, rusts, and the smuts, rots, wilts or sometimes based on the plant part they affect like the roots, stem, leaves, or sometimes they are classified on the basis of the plant they affect like the turf diseases, vegetable diseases and the crop diseases (Agrios, 1972). Plants diseases can be caused by several means: by biotic agents and or by abiotic means, so the classification of the diseases on the basis of the agents is as follows (Agrawal, 2018).

a) Infectious diseases or the diseases by the biotic means: Diseases caused by biological agents like fungi, viruses, and viroids, nematodes, and protozoa.
b) Diseases caused by various abiotic means: such as ph, drought, salinity, and the pressures and the different kinds of the population, nutrition deficiencies mineral toxicities, soil acidity.

The management of the disease can be regarded as a 'tool kit' approach to protecting crops of farmers. Crop pathologists have been producing 'tools' to protect crops over the years. Using resistant varieties is usually the first course of action to combat diseases. Chemical methods, biological measure employing organisms that attenuate the severity of disease infestation and several cultural practices could be a principal component of disease control kit.

Disease management programs are usually designed to regulate the population of disease causing organisms below levels of economic losses as well as to improve the effectiveness of crop production. The dynamics of the crop - pathogen interaction, is also a focus of disease management.

According to Maloy (2005), there are several strategies, tactics, and techniques employed in the management of diseases, and these can be grouped into one or several broad principles of action. The simplest management system comprises two principles - The first is prevention which is a management tactic employed before infection and the second principle is a treatment which is any measure employed after the plant is attacked by disease (Maloy, 2005).

However, one early proposal included four general principles of disease management, namely, exclusion, eradication, protection, and resistance. Many scholars and Maloy (1993) discuss these and other principles.

Exclusion: This principle aims at preventing the introduction of disease-causing agents (pathogens) into the farmers' field or farm. The eradication principle is to eliminate a pathogen after it is introduced into a farm so that the disease does not spread further. Protection principle works by creating a barrier between disease causing organisms and the crop or susceptible part of the crop. The resistance principle is used to assist the crop to be less susceptible to disease. Integrated Disease Management principle (IDM) employs the timely utilization of several strategies and tactics to combat the menace of disease organisms.

Cocoa is very vulnerable to the attack of pests (insects) and disease causing organisms. Pests and diseases reduce not only the quantity of cocoa produced but the quality of cocoa beans as well (David, 2005). This constitutes a major challenge for farmers. Farmer field schools (FFSs) were first developed in Indonesia in 1989 for training rice farmers in integrated pest management (IPM) (NAELS/ABU, 2008). However, the FFS extension approach has been introduced to several countries all over the world including Nigeria. The approach has also been extended to other crops like cocoa, coffee, and groundnut, besides rice. The general principles of disease control highlighted above are to be incorporated into the FFS training programme and taught to farmers. How the FFS assists farmers in the area of disease management merits consideration.

The main diseases of cocoa are black pod disease, cocoa swollen shoot, and canker. Black pod disease is the most serious disease of cocoa in West Africa (David *et al.*, 2006). Black pod disease has been controlled in different ways. Planting of resistant cocoa varieties, planting on good site, quarantine, regular field inspection, prompt harvesting, mulching, adequate spacing, pruning of trees, improvement of airflow in plantation, removal of soil from the tree trunk, promotion of soil health and use of chemicals (fungicides) have been tested and used effectively to combat and or manage the menace of black pod disease (David, 2005; Vanegtern *et al.*, 2015). Integrated Pest Management can also be used to control black pod disease.

The advantage of the use of Integrated Pest Management (IPM) in controlling cocoa diseases is the decrease in the use of agrochemicals, as well as providing an economic incentive to farmers by increasing the quality and yield of the cocoa crop. It then becomes imperative that farmers know the state of their crops and the diseases on the farm so that they can determine the best action to take. As an extension approach, how FFS has improved knowledge of farmers in this regards merits serious attention which this study is poised to examine.

West and Central African countries produce more than 72% of the world’s cocoa production (ICCO, 2015). However, this percentage may dwindle as a result of several factors including disease infestation. Thus, any training programme that can assist farmers to manage diseases in their fields will be highly appreciated. Also assessing the effect of such programme contribution to the knowledge of farmers will be highly appreciated. Since black pod disease causes the greatest loss to cocoa farmers (Adeniyi, 2019), any initiative put in place to control the menace of the disease will highly be appreciated. Thus Simo *et al.* (2014) asserted that the management of disease, especially black pod, is a serious challenge to cocoa cultivation. Since FFS as an extension approach is poised to assist farmers in solving their problems including the management of diseases, how this approach has helped farmers in managing a serious disease like black pod is worth examining. Thus, integrated pest and disease management are some of the topics in the FFS curriculum (David *et al.*, 2006).

These research questions, therefore, arise: what are the socio-economic characteristics of cocoa farmers? How has FFS improved the competence of farmers in controlling black pod disease? What is the proportion of farmers that have gained training disease control programme of FFS? In what aspects has FFS training helped farmers to combat black pod disease? The purpose of this paper is thus to examine the place FFS training in improving farmers’ competency in the control of black pod disease on their farms. The itemized objectives were to:

1. Explain the socio-economic characteristics of the respondents.
2. Identify the control measures of the black pod that FFS has helped farmers in Edo state.
3. Ascertain the differences in knowledge of FFS farmers and other farmers on the management of black pod disease of cocoa

1.1. Conceptual framework of the study

The conceptual framework guiding this study is depicted by the relationship between the variables of study as indicated in Figure 1. The independent variables include socioeconomic variables such as age, sex, marital status, educational level, farm size, farming experience, household size, and FFS status. These socioeconomic variables would invariably determine the farmers’ knowledge of the control of black pod disease of cocoa. The improved/low knowledge is expected to translate into increased/decreased farmers' welfare as indicated by a reduction/increase in farm losses and increased/decreased cocoa production. This new status of the farmer is likely to affect their socioeconomic status; for instance, improved production as a result of reduced incidence of disease may enhance the income of the farmer, and with this elevated income the farmer can now increase his farm size. On the other hand farmers with less knowledge mat witness low income and poor output. Hence the double head arrow linking the socioeconomic variable with the improved welfare (i.e. reduced farm losses and increased production) box. The intervening variables in the study which did not measure but could influence the dependent variable (Knowledge) of the farmer included government policy, the physical environment of the farmer, and the cultural setting of the community.

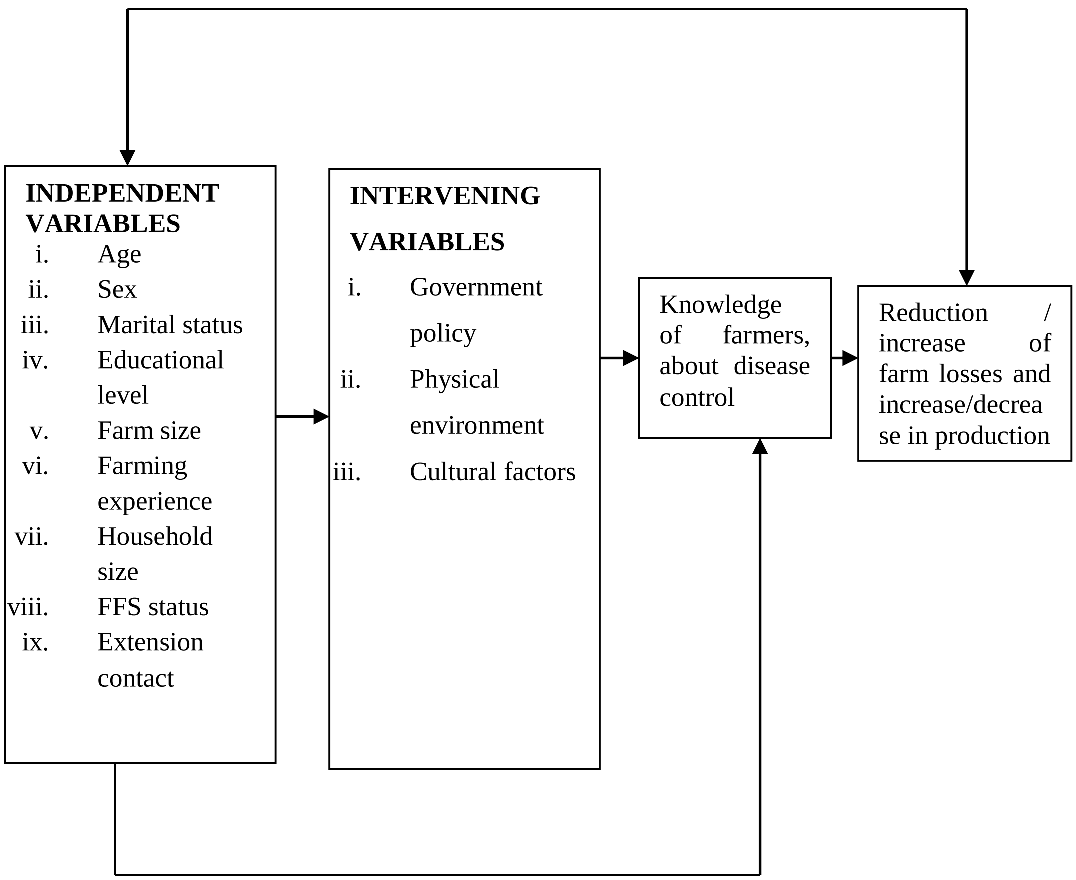

Figure 1: Conceptual framework of the study

2. MATERIALS AND METHODS

The research was carried out in the Edo State of Nigeria in 2019. Edo State was chosen because it was one of the pioneer states involved in farmer field school training. Moreover, some farmers in the State did not attend farmer field school. The farmer field school in Edo State is only for cocoa farmers, hence the selection of this group of farmers. Edo State was split off from the erstwhile Bendel State on August 27, 1991. Edo State has a population of about four million (NPC, 2006). The landmass of Edo State is 19,749 km^2 and lies between latitudes 05^{o}44' N and 07^{o}34' N and longitude 05^{o}4' E and 06^{o}E. The State has a lot of low lands except in the North part due to the presence of the Northern and Esan plateaus which range from 183 meters (Kukuruku hills) to 672 meters (Somorika hills). The State has boundaries with Kogi State (in the North), Delta State (in the East and South), and Ekiti and Ondo States (in the west). The climate of the State is characterized by two distinctive seasons - the rainy and the dry seasons.

All the registered cocoa farmers that have been participated in FFS (FFS graduates) and those that have not participated (non-FFS farmers) constitute the population of the study. The lists of the registered farmers were obtained from the Sustainable Tree Crop Programme (STCP) and the Agricultural Development Programme (ADP) offices present in the State.

The sample was composed using a multi-stage sampling procedure. The three agro-ecological zones in the State are Edo North, Edo Central, and Edo South. The concentration of cocoa farmers in Edo North who are acquainted with FFS training more than other zones led to its selection. Three local government areas in this zone - Owan East, Owan West, and Akoko Edo local government areas- were purposively selected because of the concentration of FFS training more than others. In the last stage, 10% of both FFS and non-FFS farmers were randomly selected from each of the three LGAs chosen using the list of cocoa farmers obtained from the Sustainable Tree Crops programme (STCP) and Agricultural Development Programme Offices. A total of 76 FFS farmers and 79 non-FFS farmers were randomly selected from the study area. However, only 74 non-FFS farmers were used for the study as 5 copies of the questionnaire were not returned.

A structured and validated questionnaire was developed and employed for data collection. The questionnaire sought information on the social-economic characteristics of the respondents and the FFS role in improving their knowledge in the management of diseases.

The various management options of black pod disease were obtained from the Sustainable Tree Crops Programme (STCP) office. The FFS respondents were then split into three categories based on FFS contribution to their knowledge of disease management. The FFS farmer is placed in group one if the disease management option is not new to him (i.e the farmer is familiar with the practice); the farmer is placed in group two if FFS considerably improved the knowledge of the farmer on the particular management option if the disease control practice is novel to the farmer he is categorized into group three.

Knowledge of the FFS farmers and other farmers was determined by administering some test items to them. T-tests were then used to determine whether significant differences exist between the FFS farmers and other farmers in terms of knowledge about the management of black pod disease. T-test has been used extensively for testing the difference of two means by many scholars (Kim, 2015; Vetter and Mascha, 2018; Rochon *et al.*, 2012).

3. RESULTS AND DISCUSSION

The socioeconomics characteristics of respondents are presented in Table 1. The results showed that the age range of farmers is 18 – 75 years. The mean age was about 45 years. Moreover, most of the respondents were within the economically active age group as about 78.4% of them were between 21 and 60 years old. This is an indication that youth were actively involved in cocoa farming in the study area. Thus, cocoa cultivation was carried out mostly by adults with vigour or energy to work. Osarenren *et al.* (2016) stated that farmers in this age range are usually active and this can impact positively on cocoa cultivation. Most of the respondents were males (about 78.6% FFS farmers and 90.5% non-FFS farmers). This may be due to the perennial nature of cocoa which often leads to permanent holding on land which traditionally is owned by men and also the rigorous work involved. A similar observation was made by Okorley *et al.* (2014) and Osarenren *et al.* (2016) who reported that cocoa production is dominated by males and that there is the belief that the cocoa sector demands strenuous work, which makes it more suitable for men who strictly speaking are physically stronger than women. The marital status of the respondents shows that most of them were married (64.5% FFS farmers and 70.3% other farmers), which was similar to the finding of Omoare *et al.* (2016) who observed that many cocoa farmers were married. Thus most of the respondents have responsibilities, and their family members may assist in cocoa farming. Family members may help to reduce the costs incurred in farm labour. Matata *et al.* (2010) believe that married individuals actively participate in technology development more than those not married due to the support of a marriage partner. The result of education attainment indicates that 89.5% of FFS farmers acquired formal education in one form or the other. The percentage of non-FFS farmers that had formal education is lower (73%) and as high as 27% of them had no formal schooling. This indicates high literacy among the respondents. However, the FFS farmers are more literate which may likely explain why they are involved in the FFS training programme. Mokgadi and Oladele (2013) and Akinmusola *et al.* (2016) observed that formal education has been found to have a positive influence on the adoption of innovation, including participating in a training programme like FSS. Most of the respondents are quite experienced in cocoa farming, with mean farming experience of 22years. Thus, the majority of the respondents will be willing to participate in FFS training on cocoa. Farm size of most of the respondents was small, with 75% of them possessing farm size of between 0-5 hectares as indicated in Table 2, and the mean farm size was only 4 hectares which are very small for a tree crop like cocoa. The result agrees with Okunlola and Adekunle (2000) and Osarenren *et al.* (2016) who asserted that most Nigerian cocoa farmers are smallholders. This finding implies that the respondents are mainly small scale farmers. According to Lavison (2013), farm size can affect and or be affected by the other factors determining adoption or acquisition and utilization of innovations and improved practices. The household sizes of the respondents were moderate; the mean was 7. Ogungbile *et al.* (2002) asserted that the household size can influence the adoption index either positively or negatively. Large household size can also assist in providing family labour (Nmadu *et al.*, 2015).

Table 1: Socio-economic characteristics of respondents

Variables	FFS Farmers (n = 76)		Other Farmers (n = 74)	
	Frequency	Percentage	Frequency	Percentage
Age (Years)				
0 – 20	8	10.5	6	8.1
21 – 40	22	28.9	20	27.0
41 - 60	35	46.1	38	51.4
Above 60	11	14.5	10	13.5
Gender				
Male	64	84.2	67	90.5
Female	12	15.8	7	9.5
Marital Status				
Never Married	16	21.1	12	16.2
Married	49	64.5	52	70.3
Divorce/separated	4	5.3	5	6.8
Widow/Widower	7	9.2	5	6.8
Educational Level				
No Formal	8	10.5	38	27.0
Primary	19	25.0	49	34.7
Secondary	29	38.2	38	27.0
Tertiary	20	26.3	14	9.9
Farming Experience (Years)				
Less than 11	11	14.5	5	6.8
11 – 20	22	28.9	28	37.8
More than 20	43	56.6	41	55.4
Farm Size (Hectare)				
5 and Below	57	75.0	65	87.8
6 – 10	14	18.4	5	6.8

More than 10	5	6.6	4	5.4
Household Size				
1 – 5	26	34.2	11	14.9
6 – 10	38	50.0	51	68.9
More than 10	12	15.8	12	16.2

Source: Survey data, 2019

3.1. Role of FFS in improving farmers' knowledge of the control of black pod disease

Table 2 depicts the contributions of FFS to control of black pod disease. The results in Table 2 indicated that FFS contributed immensely to the respondents' knowledge of the control of cocoa black pod disease. For example, 59.2% of the respondents were exposed for the first time to the use of resistant varieties in controlling black pod disease; 23.7%, 57.9%, 72.4%, 73.7%, 47.4%, 78.9%, and 85.5% respectively asserted that they were exposed for the first time to regular inspection of farm to remove diseased pods, regular harvesting, rational use of fungicide, plantation maintenance to increase airflow, removal of soil from the cocoa trunk, promotion of healthy soil and integrated crop disease management. FFS training also contributed substantially to improving farmers' knowledge on the control of black pod disease; 30.3%, 28.9%, 26.3%, 19.7%, 21.1%, 44.7%, 17.1%, and 13.2% respectively asserted that FFS training greatly improves their knowledge in planting resistant variety, regular inspection of farm to remove diseased pods, regular harvesting, rational use of fungicide, plantation maintenance to increase airflow, removal of soil from the cocoa trunk, promotion of healthy soil and integrated crop disease management. Although 47.4% of the respondents were already practicing regular inspections of farms to remove diseased pods, very few numbers of the respondents already know how to control black pod disease using the 7 other methods. The findings imply that FFS has contributed immensely to farmers' knowledge of the control of black pod disease, thus boosting farmers' competence in disease management. This observation agrees with that of Dzomeku *et al*. (2014) and David (2007) who observed that FFS had led to increased production of cocoa by improving farmer knowledge on how to manage their cocoa farms. Okorley *et al*. (2014) also asserted that FFS training had greatly improved farmers' competence in the control of black pod disease of cocoa.

Table 2: Role of FFS in improving respondents control black pod disease

Control measure	Role of Farmer Field School		
	Group 1	Group 2	Group 3
i. Planting of resistant varieties	8 (10.5)	23 (30.3)	45 (59.2)
ii. Regular field inspection to remove pods	36 (47.4)	22 (28.9)	18 (23.7)
iii. Regular harvesting	12 (15.8)	20(26.3)	44 (57.9)
iv. Rational use of fungicide	6 (7.9)	15 (19.7)	55 (72.4)
v. Plantation maintenance to improve airflow	4(5.3)	16(21.1)	56 (73.7)
vi. Removal of soil from cocoa trunk	6 (7.9)	34 (44.7)	36 (47.4)
vii. promotion of healthy soil	3 (3.9)	13 (17.1)	60 (78.9)
ix. Integrated crop disease management practices	1 (1.3)	10(13.2)	65 (85.5)

Source: survey data, 2019
Note: Percentages in parentheses

1 = previously familiar; 2 = FFS contributes substantially on knowledge of control method 3 = control method novel or new to farmers the percentages are in parentheses.

3.2. Differences between FFS farmers and other farmers in terms of their knowledge of Control of Black pod disease

The differences in knowledge of the control of black pod disease between FFS and other farmers are presented in Table 3. From the t-test results presented in Table 3, significant differences exist between knowledge of FFS and other farmers in the management of black pod disease in all the test items examined. This can be observed from the t-value obtained. This is a clear indication that the FFS training improved the knowledge of the cocoa farmers in managing black pod disease. The plausible reason adduced for this difference is probably due to the FFS farmers being more exposed to training on improved management practices. This finding was corroborated by that of Ajayi and Okafor (2006), David *et al.* (2006) and van de Fliert and Braun (2005), and Nmadu *et al.* (2015) who reported that FFS focuses on building farmers capacity to make well-informed crop management decisions through increase knowledge and understanding of agro-ecosystem. Several studies depict the FFS as an effective training method for the farmers (Godtland *et al*., 2003). A research carried out in the Philippines indicates that FFS graduates retain knowledge many years after the attending training (Rolas *et al*., 2002; Tripp *et al*., 2005). This knowledge acquired can assist them in making sound decisions on how to contain the menace of black pod disease.

Table 3: Distribution of respondents based on the management of cocoa black pod disease

No.	Test item	FFS Farmers (N = 76)			Other Farmers (N = 74)			
		Score	Mean	S	Score	Mean	SD	t-value
1	Planting Healthy Tree	76	1.00	0.000	12	0.16	0.511	11.50**
2	Good spacing of cocoa tree/density	76	1.01	0.000	18	0.24	0.298	13.82**
3	Causes Of Diseases	75	0.99	0.104	16	0.22	0.408	10.44**
4	Effect of light on diseases	74	0.97	0.188	6	0.08	0.366	18.04**
5	Spraying of agrochemicals	76	1.00	0.001	52	0.70	0.299	5.55**
6.	Safety precaution during spraying	76	1.00	0.000	18	0.24	0.299	13.79**
7.	Storage of agrochemical	74	0.97	0.201	9	0.12	0.562	11.01**
8.	Recommended spraying methods	72	0.95	0.380	6	0.08	0.189	21.79**
9.	Time of spraying	70	0.92	0.412	15	0.20	0.442	16.62**
10.	Sanitary Harvest	77	1.00	0.001	6	0.08	0.333	19.49**
11.	Prompt harvesting	74	0.97	0.331	35	0.47	0.297	8.95**
12.	Use of disease resistant varieties	76	1.00	0.001	23	0.77	0.422	7.78**
13.	Integrated disease management	72	0.95	0.266	12	0.16	0.349	12.51**
14.	Avoidance of Child Labour	72	0.95	0.266	18	0.24	0.415	11.09**

Source: Survey data, 2019
Note: ** Significant at P < 0.05

4. CONCLUSION AND RECOMMENDATIONS

The findings of the study revealed that FFS contributed immensely to farmers' knowledge on the control of black pod disease. From the findings, FFS training either contributed greatly to improving farmers' knowledge on how to manage black pod disease or trained most farmers on the disease control method. Moreover, the FFS farmers have more knowledge than other cocoa farmers by their exposure to FFS training. Based on the findings, these recommendations are made.

1 The nonparticipant cocoa farmers should be sensitized to FFS training since FFS training has benefitted the farmers in control of black pod disease.
2 Since FFS training is presently centered on cocoa farmers in the study area, it is a good thing that FFS training is extended to other crops.

3 The curriculum of the FFS training should be expanded to include all aspects of cocoa cultivation practices. The FFS and non-FFS farmers should be involved in formulating the curriculum.

The implementation of these recommendations will invariably minimize the menace of not only diseases but also help the farmers in making good returns from their farm business.

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