INTEGRATED PLANT DISEASE MANAGEMENT, A PANACEA FOR FOOD INSECURITY

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UNIVERSITY OF IBADAN

INTEGRATED PLANT DISEASE MANAGEMENT, A PANACEA FOR FOOD INSECURITY

An inaugural lecture delivered at the University of Ibadan

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By

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The Vice-Chancellor, Deputy Vice-Chancellor (Administration), Deputy Vice-Chancellor (Academic), Registrar, Librarian, Provost of the College of Medicine, Dean of the Faculty of Science, Dean of the Postgraduate School, Deans of other Faculties and of Students, Directors of Institutes, Distinguished Ladies and Gentlemen.

Preamble

To God be the glory, great things He has done in my life for the opportunity to give this inaugural lecture in the new Department of Botany. The original Department of Botany was a foundation Department of the Faculty of Science in 1948. The Department of Botany and Microbiology which evolved from the original Department of Botany in 1982, was eventually separated into two Departments viz., Botany and Microbiology in 2010. Therefore, I am privileged to give the first inaugural lecture in Botany since the unbundling of the Department of Botany and Microbiology in 2010.

It is my desire to start this lecture by thanking and praising God Almighty through Jesus Christ our Lord, for making this occasion a reality. I give glory to the Omnipotent, Omnipresent and Omniscience God, who has been faithful and merciful to me and my family in many ways. I thank the Creator of heaven and earth for keeping me alive to see this day. Glory be to His Holy Name.

I pay tribute to all the Professors who have delivered previous inaugural lectures in the Department of Botany and Microbiology from this University. Incidentally they were all Botanists. I must mention my supervisor and mentor, Prof. B.A. Oso who delivered his inaugural lecture on 'Fungi and Mankind' in 1981, Prof. A. Egunyomi, who delivered his lecture on 'Mosses and Mankind' in 1993, Prof. O. Osonubi, who has expanded my horizon of research in Plant Disease Management by the use of mycorrhiza and delivered his lecture on 'Botany Beyond Conventional Agriculture' in 1999. Today's lecture underscores the interrelationship of botany to Agriculture or Agricultural Sciences and Forestry.

The lecture is coming 17 years since the last one from the defunct Department of Botany and Microbiology.

My area of specialization is Plant Pathology and Mycology with special focus on plant disease control (management). This inaugural lecture is titled 'Integrated Plant Disease Management, A Panacea for Food Insecurity'. I have chosen this topic because of its importance to humanity and my interest in marrying the gown and town in Botany. In order to bring the topic into an appropriate focus, I have decided to break it into the following subheadings.

(1) What is Botany?
(2) What is a disease in Plant Pathology?
(3) Integrated Plant Disease Management
(4) Importance of plant disease to food safety
(5) My contribution to plant disease management
(6) Food security through integrated disease management

What is Botany?

Botany is the study of plants and plant products or the study of the science of plants. Botany is not just about naming plants or beautifying the environment with flowers or studying forestry. For a plant to be named, the attributes, morphology, habitat, uses, phytochemical component, anatomical characteristics, ecology, growing habitats and other characteristics must be known. Plants play a role in everyone's life and touch almost every aspect of human existence in one way or the other. Plants meet our essential basic needs of provision of oxygen, food, timber, drugs, fuel, shelter, clothing and bio-circulation of minerals in most industries. Plants are the primary producers in the food chain, all other organisms are consumers, man inclusive.

Botany has several disciplines which include Taxonomy and Biosystematics, Plant Physiology, Plant Biochemistry, Ecology, Phycology, Algology, Bryology, Palynology and Paleobotany, Ethnobotany, Plant Geography, Horticulture, Environmental Botany, Forensic Botany, Economic Botany, Plant Breeding, Plant Genetics, Cytology, Plant Pathology,

and Mycology. To study Botany as a basic science opens one up to several career opportunities in pure and applied sciences.

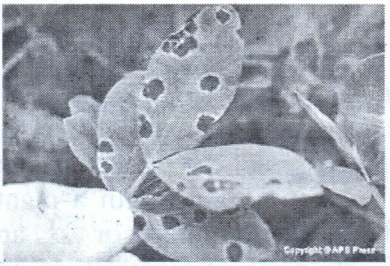
What is a Disease in Plant Pathology?

Generally, plant diseases come about as a result of certain disturbances in the normal life processes of the plant. A plant disease can briefly be defined as any problem with a plant that causes reduction in yield and/or quality; or as an abnormal growth and/or dysfunction of a plant. It is an impairment of the normal state of a plant that affects the plant's normal functioning or development. A plant generally becomes diseased when it is continuously disturbed by some agent(s) that result(s) in an abnormal physiological process which disrupts the plant's normal structure, growth, function, or other activities. It is an interference with one or more of a plant's essential physiological or biochemical systems giving rise to characteristic pathological conditions in the plant see plates A-K.

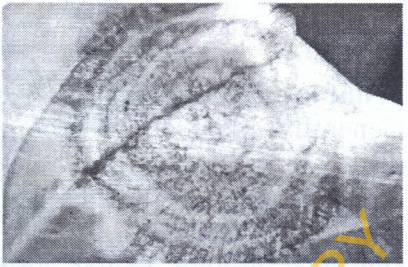
Plant diseases can be broadly classified according to the nature of their primary causal agent, either infectious or noninfectious. Some plant diseases are caused by biotic agents such as a fungus, bacterium, mycoplasma, virus, viroid, nematode, or parasitic flowering plant. The plant diseases caused by these biotic agents are termed ***infectious diseases***. Some other plant diseases are caused by abiotic agents such as unfavourable physiological factors (i.e. unfavourable growth conditions) such as deficiency or excess of temperature, soil alkalinity or acidity, disadvantageous relationships between moisture and oxygen, toxic substances in the soil or atmosphere, and an excess or deficiency of an essential mineral. The plant diseases caused by these abiotic agents are termed ***non-infectious diseases***.

For a disease to occur, three conditions must be met. Firstly, a pathogen has to be present on or in the plant. Secondly, there needs to be suitable environmental conditions for the pathogen to grow. Thirdly, the plant must be susceptible to the disease.

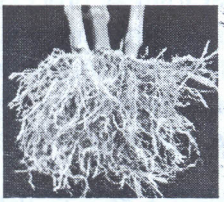
Examples of Plant Diseases



(A) Early leaf spot of groundnut

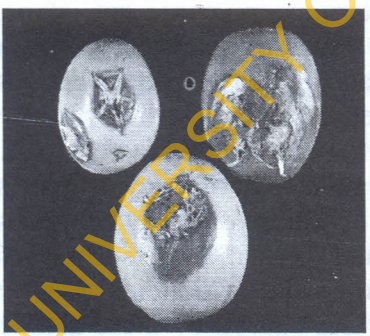


(B) Taro leaf blight

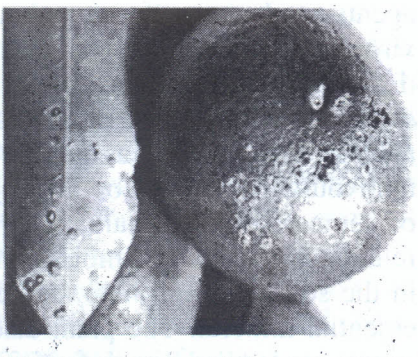


(C) Root rot of maize (*Zea mays*)

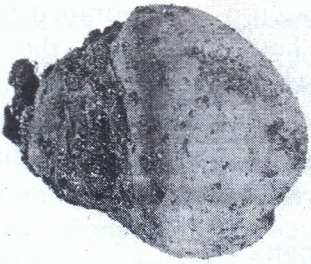
(D) Black rot of soybean



(E) Fruit rot of tomato



(F) Orange fruit with brown rot lesion

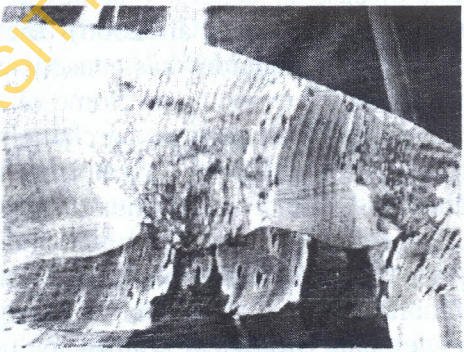


(G) Potato tuber rot

(H) Yam tuber infested with white scale insects

(I) Kolanut rot

(J) Cocoa pod rot



(K) *Shigatoka* disease of banana

The fate of any disease on a crop is determined by the interactions of the pathogen, host plant, and the ideal environment. The interaction, which is known as disease triangle (fig. 1), plays a critical role in determining the nature of plant disease epidemics in the course of disease management programmes.

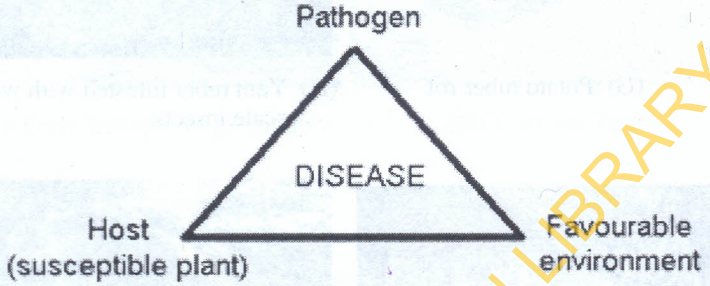


Fig. 1: Disease triangle

Integrated Plant Disease Management

Many attempts have been made by researchers across the globe to stop the menace of plant disease. Some of the methods that have been employed in controlling various plant pathogens include: Physical, Chemical, Biological and Cultural controls. Although effective and efficient management of plant disease is generally achieved by the use of synthetic pesticides (Kiran et al. 2006), the recurrent and indiscriminate use of fungicides has caused serious havoc to human beings and the environment. Some of these problems which are recognized as mutagenic, carcinogenic, teratogenic (Babu et al. 2008), are known to cause serious threats to human health and the existing human eco-geographical conditions. Therefore, the need for human and environmental friendly approach in controlling plant diseases has led to the global acceptability and increased use of biological control in disease management. Biological control includes the use of natural defence mechanisms, mycorrhiza, antagonistic micro-organisms, botanicals/biofungicides/plant extracts, and soil or organic amendments.

Importance of Plant Disease to Food Safety

Plant diseases have caused severe losses to humans in several ways. Families have been uprooted and displaced as a result of starvation due to famine occasioned by huge loss of crops. The diet and eating patterns of some families and communities have been permanently altered due to similar reasons. Consequently, some communities have become dependent on imported foods, often replacing balanced diets with processed foods that cause further health problems. Plant diseases have caused catastrophes of no small measure in which large areas of land of planted food crops were destroyed. This has led to certain countries of the world to be inadequately fed at some time in the past. Plant diseases have also been severally documented in the reduction of production and quality of food, fibers and biofuel crops. Losses of important crops to postharvest diseases, especially when farms are far from markets and/or effective postharvest storage facilities are not in place, have also been well documented. Many postharvest pathogens have been reported to produce toxins that pose serious health problems to consumers. Furthermore, plant diseases have been known to devastate natural ecosystems, leading to worse environmental problems caused by habitat loss and poor land management.

My Contributions to Plant Disease Management

Use of Natural Defense Mechanism in Disease Management

One of my humble contributions to integrated disease management started with the research in exploiting the biochemical defence mechanisms of plants in disease control. This was carried out by evaluating the qualitative and quantitative activities of phenolic compounds of kolanut in the preservation of two varieties of edible kolanut viz., *Cola nitida* (*Gbanja/Okoro*) and *Cola accuminata* (*Abata*) (Odebode 1996). The study clearly indicated the presence of large quantities of phenolic constituents in the kolanuts when compared with other fruits such as grapes, pears, apples and

oranges. The extracted phenol compounds were tested on the post-harvest pathogens *Botryodiplodia theobromae* and *Fusarium palidoroseum* which cause black or mummified rot and dry rot of kolanut. It was found that the extracted phenolic compounds inhibited both the spore germination and mycelia growth of the pathogens (Odebode and Oso 1995, 1996). This prolonged the preservation quality of kolanuts in storage better than other fruits.

The study revealed that as the level of the phenolic compounds or oxidative enzymes in the kolanut decreased, the nuts became more susceptible to storage pathogens (figs. 2, 3 & 4). To maintain a minimum level of phenolic concentration required to preserve the kolanuts, the study showed that the nut should be stored in an environment with relative humidity that would keep the nuts fresh as well as protecting them from dryness. On evaluation of leaves used traditionally for preservation of kolanuts, it was discovered that the leaves assisted in the retention of natural biochemical defense compounds at a level that would not degrade the kolanuts for a period of 3 months.

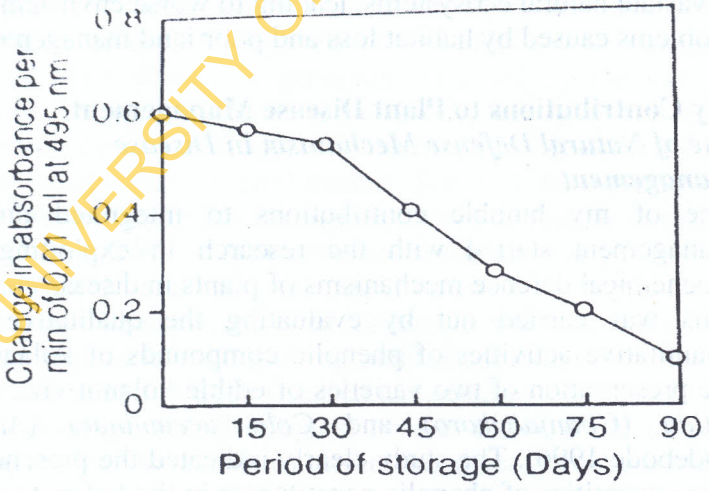


Fig. 2: Phenol oxidase activity in kolanuts stored for periods of up to 3 months (After Odebode 1996).

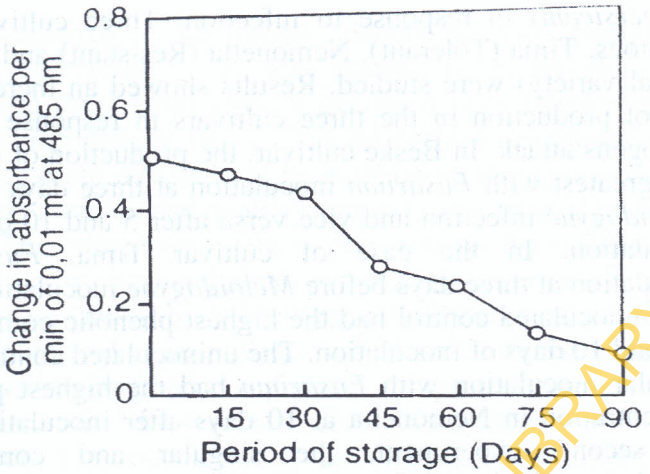


Fig. 3: Peroxidase activity in kolanuts stored for periods of up to 3 months (After Odebode & Oso 1995).

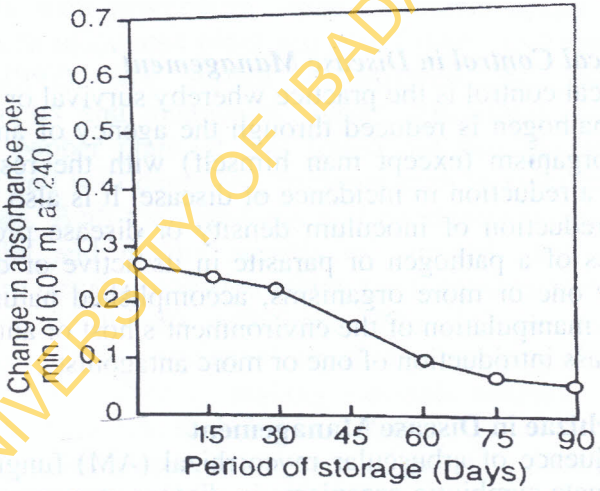


Fig. 4: Catalase activity in kolanuts stored for periods of up to 3 months (After Odebode & Oso 1995).

Akintayo (2015) investigated the interactions between soil borne fungus, *Fusarium oxysporum* f.sp *lycopersici* and parasitic nematodes, *Meloidogyne incognita* in relation to the quantity of phenol produced in tomato (*Solanum*

lycopersicum) in response to infection. Three cultivars of tomatoes, Tima (Tolerant), Nemonetta (Resistant) and Beske (Local variety) were studied. Results showed an increase in phenol production in the three cultivars in response to the pathogens attack. In Beske cultivar, the production of phenol was greatest with *Fusarium* inoculation at three days before *Meloidogyne* infection and vice versa after 5 and 10 days of inoculation. In the case of cultivar Tima, *Fusarium* inoculation at three days before *Meloidogyne* inoculation and the uninoculated control had the highest phenolic compound at 5 and 10 days of inoculation. The uninoculated control and singular inoculation with *Fusarium* had the highest phenol concentration in Nemonetta at 10 days after inoculation. In the second experiment, the singular and combined inoculations had significant effects on growth yield and disease parameters ($p<0.05$). These experiments established the potency of natural defense mechanisms in disease control.

Biological Control in Disease Management

Biological control is the practice whereby survival or activity of the pathogen is reduced through the agency of any other living organism (except man himself) with the result that there is a reduction in incidence of disease. It is also defined as the reduction of inoculum density or disease producing activities of a pathogen or parasite in its active or dormant state by one or more organisms, accomplished naturally or through manipulation of the environment's host or antagonist or by mass introduction of one or more antagonists.

Mycorrhizae in Disease Management

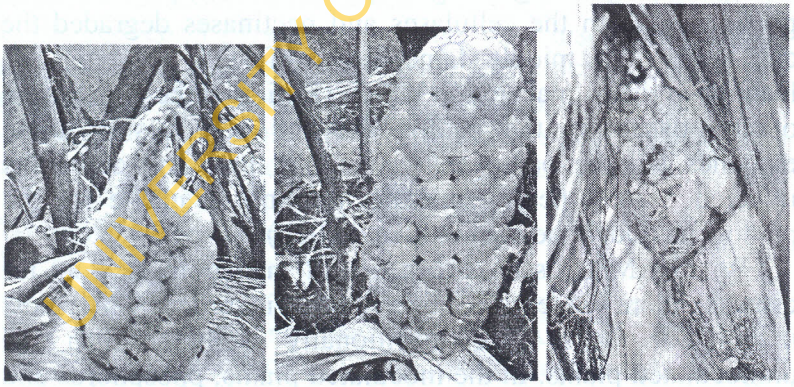
The influence of arbuscular mycorrhizal (AM) fungi which are obligate symbiotic organisms in disease management has been attributed to increased mineral nutrients absorption rather than to a direct influence of the mycorrhizal fungus itself, since AM fungi explore greater amounts of soil and absorb more phosphorus and certain other minerals than do non-mycorrhizal roots. This has also been shown to be a benefit to plants attacked by pests and diseases (Dehne and Schonobeck 1975; Dehne 1982; Perrin 1991).

Mycorrhizal colonization decreases the pathogenic effects of certain feeder root disease fungi by physically excluding them from already occupied sites (Becker 1976; Stewart and Pfleger 1977). This information prompted us to investigate the influence of mycorrhiza in managing root rot of pepper, tomato and quality protein maize, caused by *Striga lutea.* This was done in the experiment on the influence of arbuscular mycorrhizal fungi on disease severity of pepper and tomato caused by *Sclerotium rolfsii.* Results showed that the tomato and pepper plants inoculated with the pathogen expressed wilting and damping off symptoms, whereas those inoculated with mycorrhizae before pathogen had significant symptom suppression (such as dieback, defoliation, leaf number, height and diameter, abortion of flowers and fruiting). The above ground biomass of simultaneously inoculated plants was higher than the uninoculated controls or plants with mycorrhiza alone. Nutrients uptake in the mycorrhiza inoculated plant was also higher (Odebode et al. 1995, 1997). We further investigated the basis for pathogenesis and interaction among mycorrhiza, pathogen and the pepper plant. It was found out that the pathogen secreted cell wall degrading enzymes such as cellulases, and pectinases. Both the cellulases and pectinases degraded the cell walls and middle lamella of infected plant tissues, leading to tissue maceration which facilitated the penetration of the tissue by the pathogens. The activities of these enzymes aid the pathogens' attack by breaking down the infected tissues thereby making nutrients available for the pathogens (Odebode et al. 2001a, 2001b).

When AM is used as a means of managing the root rot disease, there were two observations recorded. First, AM inoculated plants were nutritionally healthier than the uninoculated plants. In the inoculated plants, phosphorus and other nutrients were made more available by AM hyphae than in the uninoculated plants and the former were therefore able to withstand and resist pathogenic infection better than the latter (Salami 1999; Odebode et al. 2001; Odebode and

Salami 2005). Secondly, the cell wall degrading enzymes e.g. polygalacturonases and PME were counteracted with effective AM by keeping in check the activities of the degrading enzymes. In addition, the mycorrhizal fungi were able to stimulate higher production of catalase, peroxidase and polyphenoloxidase (oxidative) enzymes which modified phenolic compounds for inhibitory substances such as quinones against the pathogens (Odebode et al. 2001a, 2001b). The overall effect of mycorrhiza inoculation in this study was the restriction of the inward invasion of the pathogen into the plant roots, which invariably reduced disease incidence severity.

Olowe (2016) investigated the effects of a Arbuscular mycorrhizal fungi (*Glomus deserticola* and *Glomus clarum*) on ear rot disease of maize (*Zea mays* L.). Results showed that the protection of plants against pathogenic organisms depends on the performances of their growth and yield characters. The inoculation of arbuscular mycorrhizae fungi in maize significantly improved the growth characters and there was a significant reduction in ear rot severity of the crop (fig. 5).



Glomus clarum + T2L COMP.4 | *G. deserticola* +T2L COMP.4 | Uninoculated (Control)

Fig. 5: Effects of arbuscular mycorrhizal fungi on ear rot disease of maize: (A) with *Glomus clarum;* (B) with *G. deserticola* (C) Uninoculated (Control) (After Olowe 2016).

Oyewole (2014), studied the effects of arbuscular mycorrhizal fungi *Glomus deserticola* and *Gigaspora gigantea* on drought tolerance at vegetative stage of growth, and charcoal rot caused by *Macrophomina phaseolina* on cowpea cultivars IT990K-277-2, IT84S 2246-4 and IT06K123-1. In the experiment, the plants treated with *G. deserticola* and *G. gigantea* exhibited an improved drought tolerance compared with the non mycorrhizal treatment under stress. The number of infection loci within the root system was reduced as a result of AM fungal colonization thereby reducing charcoal rot infection of the cowpea. The three cowpea cultivars showed high susceptibility to *M. phaseolina*, but the AMF inoculated plants had significant resistance to the pathogen. Another research work by Oyewole (2014) showed the potentials and ability of the arbuscular mycorrhizal fungi in improving drought tolerance of some cowpea cultivars and the symbiotic defence mechanisms that revealed their antagonistic characteristics against the pathogen *M. phaseolina*, that causes charcoal rot of cowpea. It was concluded from the result that AM fungi are good biological agents which control abiotic and biotic infections.

The Use of Antagonistic Microorganisms in Disease Management

Antagonistic microorganisms are biotic agents that either suppress or inhibit growth of another biotic agent. The activities of antagonistic microorganisms can be expressed in three major areas, single or in combination, and these are;

(1) Competition
(2) Antibiosis
(3) Hyperparasitism

Competition

Competition can be defined as an active demand in excess of the immediate supply of materials or conditions in which one organism has advantage over another. It is an indirect rivalry of two species (pathogen and antagonist) for some features of

the environment that are in short supply e.g. oxygen, carbon, water and mineral nutrients, resulting in the overall suppression of pathogen's activity. Competition for nutrients is probably the most common mechanism in biocontrol, and other mechanisms only serve as facilitating mechanisms (Deacon and Berry 1992).

Antibiosis

This is a condition in which one or more metabolites excreted by an organism have harmful effects on one or more other organisms. Examples of such antibiotic compounds which may damage the pathogens as well as various compounds that may enhance the pathogen in maintaining a favourable balance as a portion of the biota, include dermadine, trichodermin, acetaldehyde, alamethicine, viridian, etc. (Wells, 1988). Generally, extracellular hydrolytic enzymes produced by *Trichoderma* spp. are considered important determinants of the antagonistic ability of these fungi (Thrane et al. 2000). Cell-free metabolites of *Trichoderma virens* DAR74290 have been found to completely inhibit the growth of *Phytophthora erythroseptica in vitro* (Eteberian et al. 2000).

Hyperparasitism

This is a condition whereby an organism directly harms another organism in order to benefit from the harmed one, e.g. species A inflicts harm by the direct use of species B for its own benefit. Antagonism is operated through parasitism and predation which include hyperparasitism, myco-parasitism, direct parasitism, interfungus parasitism, etc. (Sharma and Sankaran 1988).

The plant's rhizosphere and rhizoplane are natural habitats representing a heterogeneous population of microbes. These microbes are brought on plant surface by air and there is a continuous interaction among microbial metabolism, host metabolism, physical factors and ecological niche of the plant surface. Due to these established interactions, plants in a natural state possess a relatively

stable biological balance of the microbes on their surfaces. These microbes which are subjected to various environmental fluctuations and stresses develop in response to factors such as pre-harvest and post-harvest activities over a growing period. Some of these organisms may also prevent pre-harvest and post-harvest pathogenic infections of plants (Baker and Cook 1974). There are reports on the activities of antagonistic microorganisms in the control of pathogenic fungi and bacteria of crops such as apple, citrus, tomato, avocado, etc. My own contribution in this area was on crops such as pepper, tomato, maize, cocoa, citrus, banana and plantain.

My first research on antagonistic activity was by isolating fungal flora on pepper leaves, flowers and fruits in the field during the planting season and then screening them against rot pathogens isolated from pepper obtained from various markets in Ibadan. Out of 29 different *Phylloplane microflora* isolated from leaves, flowers and fruits of a field grown pepper (*Capsicum annum*), only *Trichoderma* species, viz., *T. harzianum*, *T. viride*, *T. pililuferum* and *T. longibrachiatum* were obtained. The *in vitro* screening showed that the *Trichoderma* species had moderate to strong antagonistic activities on the post-harvest pathogens *Rhizopus nigricans*, *Aspergillus niger*, *Penicillium citrium* and *Oidium* sp. The mode of antagonism was by nutrient competition. Successful antagonism occurred when the antagonists were inoculated 24 hours before the pathogens (Odebode and Sobowale 2001).

In another experiment to examine the antagonistic potentials of *Trichoderma* species resident on maize plant against the pathogen *Fusarium moniliforme* causing maize stem rot, six *Trichoderma* species were found to successfully control the pathogen both *in vitro* and in the field (see figs. 6, 7 & 8). The *Trichoderma* species, namely, *T. harzianum* (strains 3 and 4), *T. hamatum, T. polysporum, T. viride, T. longibrachiatum, T. pseudokoningii,* strains 1 to 5) were able to compete successfully with the pathogen as endophytes within the maize stem tissues (Sobowale et al. 2005).

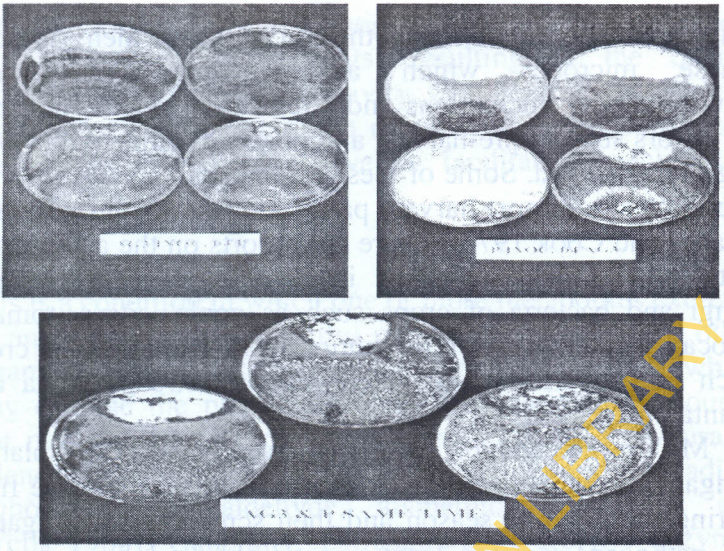


Fig. 6: *Trichoderma harzianum* strain 3 successfully parasitizing *Fusarium moniliforme in vitro* (After Sobowale et al. 2005).

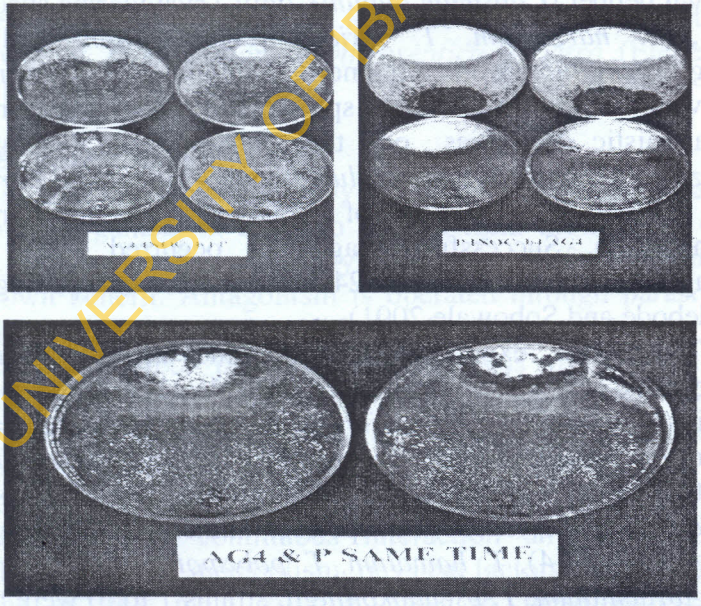


Fig. 7: *Trichoderma harzianum* strain 4 successfully parasitizing *Fusarium moniliforme in vitro* (After Sobowale et al. 2005).

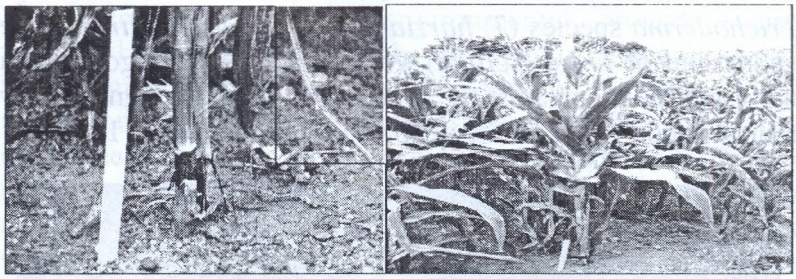


Fig. 8: Field inoculation of *Trichoderma* species and *Fusarium verticillioides* within maize stem (After Sobowale et al. 2005).

In another experiment, the phyto-beneficial effects of rhizobacteria, specifically *Enterobacter* species were evaluated on maize seedling health and growth. Out of the 19 isolates examined, two were remarkable in their phosphate solubilization efficiency (PSE > 70%), chitinase enzyme activity (CEA > 85%) and antifungal activity with evidence of no or low disease expression in maize seedling. The selected isolates (OSR7 and IGGR11) were identified and 16S rDNA revealed both isolates as *Enterobacter* species. Re-evaluation of both isolates ascertained that their combined effects were more effective on maize seedling than their individual effects. Their combinations completely suppressed pathogenic activity of *Fusarium verticillioides* on maize seedling with evidence of no disease symptoms. Maize plants that received other treatments significantly ($p < 0.05$) expressed varied seedling disease symptoms such as leaf curl and stem rot. Apart from treatment T2 (maize + pathogen), the combination of other treatments significantly ($p < 0.05$) enhanced seedling height, stem girth, leaf area, nitrogen and potassium contents. The phyto-beneficial effects of these *Enterobacter* species suggested that they could be employed as bio-inoculants for maize seedling health and growth (Abiala and Odebode 2015).

Adedeji et al. (2005, 2006) conducted an experiment to investigate the antagonistic potential of *Trichoderma* species native to cocoa plant and its rhizospere against the pod rot pathogens *Phytophtora megakarya.* In the results, the

Trichoderma species (*T. harzianum, T. viride, T. atroviridae* and strains of *T. asperellum*) were found to be antagonistic *in vitro* and *in vivo* against the pod rot pathogen by significantly reducing pod rot in all the cocoa varieties (figs. 9 & 10).

Fig. 9: Pathogenicity of bio-agents and *P. megakarya* on cocoa pods (After Adedeji 2008).

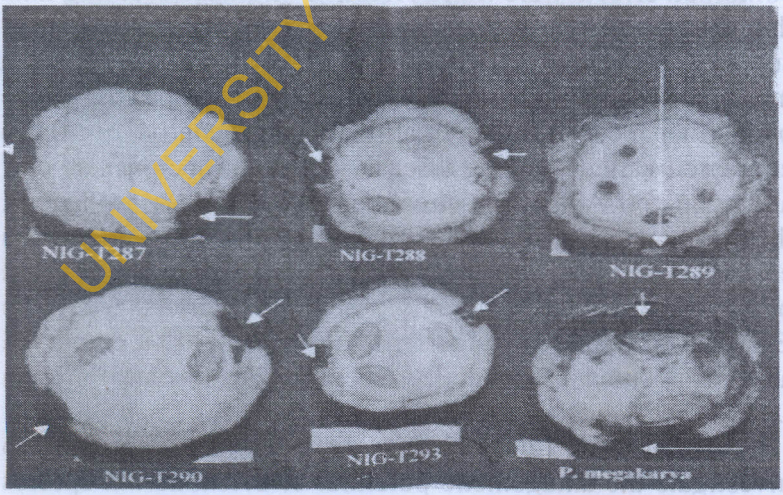


Fig. 10: Pathogenicity of bio-agents and *P. megakarya* on cocoa pods (cross-sectional view of inoculated pods) (After Adedeji 2008).

Use of Botanicals as Biofungicides

The increasing trend in environmental protection has prompted efforts to search for environmentally and toxicologically safe and efficacious crop and animal protection agents (pesticides). Likewise, the increasing incidence of evolving pesticide resistant pests has contributed to enhance efforts to develop alternatives for pests control. In this respect, natural products are considered to be potential sources for development of biodegradeable pesticides. Plants are known to produce a variety of secondary metabolites, which are bioactive and thus may have inhibitory effects on bacteria, fungi, insects and other microorganisms that cause disease on plants. My humble contributions in biofungicides research began in 1996 when an experiment was conducted to control *Botryodiplodia theobromae*, *Aspergillus niger*, *A. flavus* and *A. ochraceus* which were implicated in the rot of *Citrus sinensis* (orange), with leaves of *Ocimum gratissimum*, *Nauclea latifolia*, *Senna alata, Cajanus cajan* and *Anacardium occidentalis*. Extracts from these plants had significant fungicidal effects on the rot pathogens by inhibiting the pathogens' mycelia in liquid medium (*in vitro*) and also by controlling as much as 85% of rot diameter on the orange (*in-vivo*) (Odebode and Che 2001).

In another experiment, the antimicrobial activities of constituents that were extracted from *Isolona cauliflora, Cleisto-chlamy kirkii, Uvaria sheffleri* and *Artabotrys brachypetalus,* were found to inhibit the mycelia of *Fusarium solani, Botryodiplodia theobromae, Aspergillus niger* and *A. flavus* isolated from diseased fruits (Odebode et al. 2004, 2006). The constituents were found to be caulidone E and F, Pinocembriod, oxyheptanoid, dimmer 3,5 dimethoxycarvacol, acetogenins and Schefflone. In another experiment, the fruit rot and necrotic lesions on both green and ripe tomato fruits in a commercial farm were successfully controlled with extracts from *Calotropis procera, Adansonia digitata, Manihot esculenta, Jatropha curcas* and *Magnifera indica* (Etawere 2012). The phytofungicidal potentials of aqueous extracts of *Mangifera*

indica and *Jatropha curcas* on the *Fusarium* pathogens of millet seedlings in southwestern Nigeria were also studied in another experiment. The aqueous extracts of *M. indica* and *J. curcas* prepared at 0.15, 0.30 and 0.45 mg/ml concentration levels were evaluated *in-vitro* using standard methods. The *in-vivo* experiment was carried out using soil inoculation method in a completely randomized design with three replications. Data on percentage mycelial inhibition, growth characters, disease incidence and severity were obtained, and statistically analyzed.

Based on the *in-vitro* experiment, *J. curcas* significantly ($p<0.05$) inhibited the mycelial growth of *Fusarium* pathogens at increasing concentrations better than *M. indica*. The *in-vivo* result showed that *J. curcas* at 0.15, 0.30 and 0.45 mg/ml concentrations significantly ($p<0.05$) suppressed the effects of *F. anthophilum*, *F. verticillioides* and *F. oxysporum*. Similarly, *M. indica* at 0.30 and 0.45 mg/ml concentrations were observed to show significant ($p<0.05$) effect on *F. verticillioides* and *F. scirpi*. However, both extracts significantly ($p<0.05$) reduced the incidence and severity of disease caused by *F. anthophilum* and *F. oxysporum* at concentration levels tested in comparison to the controls. There was no significant correlation between the inhibitory effects of the extracts ($p<0.05$) and days of observation (*in vitro*) and also with the growth characters (*in vivo*). The *Fusarium* spp. showed significant inverse ($p<0.05$) relationship with disease severity while a significant ($p<0.05$) correlation existed between the extracts and disease severity. Therefore, the botanicals of *J. curcas* and *M. indica* were considered effective against *Fusarium* pathogens of millet seedlings. It was thus concluded that they could be employed in large-scale farming for sustainable millet production in Nigeria (Akanmu et al. 2013).

Management by Organic Soil Amendment

Efforts were also made at using organic amendments of soil in controlling root rot disease. Our studies showed that amendments of the soil with chicken manure, wood ash and

composted neem and *Ocimum gratissimum* (Efinrin) leaves suppressed root rot incidence and severity of disease in pepper plant (Odebode and Shehu 2001). Poultry manure was also found to significantly reduce disease incidence and severity of pepper veinal mottle virus (PVMV) on pepper (Fajinmi and Odebode 2006).

The effects of three organic soil amendments with cassava peel (*Manihot esculenta* Cranz), sawdust of *Gmelina arborea* Roxb and leaves of *Cedrella odorata* L. singly and in combination on the stalk rot of maize (*Zea mays* L.) caused by *Fusarium verticillioides,* were investigated in another experiment. All the treatments at different concentrations were found to have significantly different effects on plant heights, number of leaves, leaf areas and stem girths. All treatments also had significant effects on disease indices and disease severities of the treated plants compared to controls. The root weight of plants that received all treatments were also significantly higher than the control. Plants treated with cassava peels combined with *C. odorata* had the lowest disease index and severity.

It was submitted in this experiment that soil amendments can be of benefit to maize production but may be effective at different concentrations. Use of combined treatments such as cassava peels and *C. odorata,* which competed favorably with *F. verticillioides* was also suggested as a good soil amendment method against such fungi. It was also concluded here that the severity of stalk rot of maize can be reduced significantly in amended compared with unamended soil (Abimbola 2015).

Management by Host Resistance

The tolerance or susceptibility of quality protein maize genotypes ILE- OB, ART-98-SW4 OB, ART-98-SW5OB and ART-98-SW6-OB to *Striga lutea* infestation were examined in another experiment. The results showed that ART-98-SW5-OB and ART-98-SW6-OB were highly tolerant, with *Striga* damage rating (SDR) of 1.18-2.48; ART-98-SW4-OB was moderately tolerant with SDR of

3.59-4.57, while ILEI-OB was highly susceptible with SDR of 8.61-8.72 to *Striga* infestation. Phenotypic coefficient of variance (PCV) was higher than Genotypic coefficient of variance (GCV) for tasselling length (27.9% and 24.5%), stem diameter (29.1% and 27.4%), and husk cover (26.3% and 23.4%). High H_2b (53- 98.1%) was observed for fifteen traits, medium H_2b for moisture content (48%) and SDR (50%), while SEC had low H_2b (10%). SDR and HC traits had highest genetic advance of 58. Genotype x Environment interactions were highly significant ($p<0.01$) for grain yield and field weight. The first, second and third PCA recorded 38.0%, 25.0% and 23.0% respectively in the three environments. The best yield components in maize improvement could be identified by fifteen traits. Cultivars with broad-based tolerance to *Striga lutea* can be developed from ART-98-SW5-OB and ART-98-SW6-OB (Olawuyi et al. 2013a).

Disease Management by Integration

Our observation showed that better management or control of diseases was achieved when two or more management efforts were adopted. The combined impact of histological and anatomical structure of *Dioscorea alata* L. (water yam) on its resistance to anthracnose disease, caused by *Colletotrichum gloeosporoides* Penz. in three agro-ecological zones in Nigeria was evaluated in another experiment. The studies showed differences between the morphological structures of leaves of resistant and susceptible genotypes. The susceptible genotypes had more numerous stomata on lower epidermal surface and thinner cuticle through which the pathogen could penetrate into the plant cell easily. The cuticle of the resistant genotypes was thicker than the susceptible ones. Results in this experiment suggested that resistance in *D. alata* could be attributed to the inability of *C. gloeosporiodes* to easily penetrate the thick cuticle. Two landraces, TDa 289 and TDa 294 showed the highest level of resistance out of the 23 genotypes evaluated (Aduramigba-Modupe 2001, 2005; Aduramigba-Modupe et al. 2010, 2012). The result obtained here, which was due to a combination of histological and

anatomical make-up of the yam genotypes, further underscores the importance of integrated disease management.

Olawuyi et al. (2011, 2013b) conducted an experiment to examine the effects of combined treatments—'genotype resistance' and 'influence of AMF', on *Striga* emergence in maize (*Zea mays* L.). The AMF in the treatment combinations included *Glomus clarum*, *G. deserticola*, *G. mossae* and *G. gigantea*. *Glomus clarum* was found to significantly ($p<0.01$) reduce the *Striga* emergence and *Striga* damage rating. This ultimately increased plant height and grain yield in ART-98-SW5-OB.

Salami et al. (2001) examined the interaction of arbuscular mycorrhiza fungus with the pathogen *Phytophtora infestans* and antagonist *Trichoderma* sp. on growth of pepper (*Capsicum annum*). In the result, pepper seedlings simultaneously inoculated with the three micro-organisms had good growth parameters, such as early and high flowering incidence, fruit maturity, increase in leaf number, plant heights and growths. However, the effect of the pathogen was highly suppressed in the treatment. The significance of the study was that the interactive effects of the antagonistic microorganism and mycorrhiza prevented the disease severity and stimulated plant growth. This also underscores the critical role of integrated approaches in disease management.

Odebode and Sheu (2001) investigated the effects of different treatment combinations on incidence and severity of root rot disease of pepper (*Capsicum annum* L.). The plant age and soil amendments with chicken manure, wood ash and neem leaf were found to suppress the disease to a significant extent in the plant.

Adedeji et al. (2010) examined the ability of certain microorganisms with promising antagonistic potential to withstand common fungicides used in controlling *Phytophthora* pod rot of cocoa both *in-vitro* and in the field. The treatments were three fungicides, five bio-agents, fifteen combinations of fungicides and bio-agents, while the control consisted of unsprayed trees.

Funguran-OH, ridomil gold and copper sulphate were found to be significantly tolerated by different strains of *Trichoderma asperellum* which were abundant in the cocoa ecological zones (Ibadan, Owena, Ibeku and Ikom). These *Trichoderma* strains were found to be non-pathogenic to cocoa, but were able to colonize and persist in the cocoa pod, effectively controlling *Phytophthora* pod rot (tables 1 and 2). They were therefore recommended as biopesticide and Integrated Pest Management (IPM) component for sustainable control of pod loss in cocoa farms.

Adedeji et al. (2010) examined the comparative efficacy and economic viability of *Trichoderma* strains as bio-control agents for the control of *Phytophthora* pod rot of cocoa in Nigeria. Data were collected on total pod produced (TP), total number of diseased pods (DP), and total number of fermentable pods per tree per treatment (FP), while revenue accrued (RA) and revenue-cost-ratio were also determined accordingly. All the bio-agents significantly reduced the percentage pod rot on the field (tables 3 and 4). The highest mean pod rot incidence among the treated pods was significantly lower than the control. This was observed on BA *T. asperellum* strain 1 sprayed plots. Funguran OH + NIG-T289 produced the highest (757) number of pods while the least pod production (312) was observed with Copper Sulphate + *T. asperellum* strain 2 (F3BC) treated plots. The highest revenue-cost-ratio (69.45) was obtained from Copper Sulphate treated plots, while the least revenue-cost-ratio (2.85) was obtained from Ridomil Gold + *T. asperellum* strain 3 treated plots. *T. asperellum* strain 4 performed better than other bio-agents and most of the other treatments when applied sole resulted to 45.90 comparative efficacy and economic viability. These bio-agents were successfully combined with fungicides thereby reducing the frequency of fungicides application from four to one with significant pod rot reduction in the field, comparatively higher yield and more profit (high revenue-cost-ratio).

Table 1: Pod Rot Development as affected by Bio-control Agents and Fungicides Application in Field Trial

Treatment	Mean % Pod Rot
*BA	16.91[b]
BB	12.35[bc]
BC	14.59[bc]
BD	12.79[bc]
BE	9.28[bc]
F1	7.20[c]
F2	11.65[bc]
F3	15.28[bc]
F1BA	11.09[bc]
F1BB	11.66[bc]
F1BC	10.44[bc]
F1BD	13.18[bc]
F1BE	14.89[bc]
F2BA	8.01b[c]
F2BB	11.31[bc]
F2BC	9.50b[c]
F2BD	12.08[bc]
F2BE	14.22[bc]
F3BA	10.41[bc]
F3BB	16.04[bc]
F3BC	8.82[bc]
F3BD	10.22[bc]
F3BE	14.81[bc]
Control	30.14[a]

NB: Means with the same letter in the same column are not significantly different (P< 0.05) using Duncan Multiple Range Test (DMRT).

*BA= NIG-T287
BB= NIG-T288
BC = NIG-T289
BD = NIG-T290
BE = NIG-T293
F1 = Ridomil Gold
F2 = Funguran OH
F3 = Copper Sulphate
F1BA = Ridomil Gold+NIG-T287
F1BB = Ridomil Gold+NIG-T288
F1BC = Ridomil Gold+NIG-T289
F1BD = Ridomil Gold+NIG-T290
F1BE = Ridomil Gold+NIG-T293

F2BA = Funguran OH + NIG-T287
F2BB = Funguran OH + NIG-T288
F2BC = Funguran OH + NIG-T289
F2BD = Funguran OH + NIG-T290
F2BE = Funguran OH + NIG-T293
F3BA = Copper sulphate + NIG-T287
F3BB = Copper Sulphate + NIG-T288
F3BC = Copper Sulphate + NIG-T289
F3BD = Copper Sulphate + NIG-T290
F3BE = Copper Sulphate + NIG-T293

Control= unsprayed stands

Source: Adedeji et al. 2010

Table 2: Pod Production as affected by Bio-control Agents and Fungicides Application in Field Trials

Treatment	Total green pods	Mean green pods
*BA	525	44.33^{ab}
BB	483	39.42^{bc}
BC	407	36.75^{bc}
BD	492	41.00^{bc}
BE	639	53.17^{a}
F1	360	32.92^{bc}
F2	501	41.58^{bc}
F3	614	51.17^{a}
F1BA	451	37.83^{bc}
F1BB	314	30.00^{cd}
F1BC	312	26.17^{cd}
F1BD	630	51.67^{a}
F1BE	494	40.08^{bc}
F2BA	532	44.58^{ab}
F2BB	676	55.17^{a}
F2BC	757	62.83^{a}
F2BD	744	62.67^{a}
F2BE	517	43.67^{ab}
F3BA	395	33.83^{bc}
F3BB	450	37.50^{bc}
F3BC	312	26.75^{cd}
F3BD	412	33.92^{bc}
F3BE	521	44.33^{ab}
Control	427	37.83^{bc}

NB: Means with the same letter in the same column are not significantly different ($P< 0.05$) using Duncan Multiple Range Test (DMRT).

*BA= NIG-T287
BB= NIG-T288
BC = NIG-T289
BD = NIG-T290
BE = NIG-T293
F1 = Ridomil Gold
F2 = Funguran OH
F3 = Copper Sulphate
F1BA = Ridomil Gold+NIG-T287
F1BB = Ridomil Gold+NIG-T288
F1BC = Ridomil Gold+NIG-T289
F1BD = Ridomil Gold+NIG-T290
F1BE = Ridomil Gold+NIG-T293

F2BA = Funguran OH + NIG-T287
F2BB = Funguran OH + NIG-T288
F2BC = Funguran OH + NIG-T289
F2BD = Funguran OH + NIG-T290
F2BE = Funguran OH + NIG-T293
F3BA = Copper sulphate + NIG-T287
F3BB = Copper Sulphate + NIG-T288
F3BC = Copper Sulphate + NIG-T289
F3BD = Copper Sulphate + NIG-T290
F3BE = Copper Sulphate + NIG-T293

Control= unsprayed stands

Source: Adedeji et al. 2010

Table 3: Pod Yield Parameters as affected by Bio-control Agents, Fungicides and their Combinations

Treatment	Total pods	Diseased pods	Fermentable pods	Bean yield (Ha/Kg)	*Treatment effect (Ha/Kg)
*BA	58.30	9.89	48.41	1258.66	511.94
BB	53.66	6.62	47.04	1223.04	476.32
BC	45.22	6.81	38.41	998.66	251.94
BD	54.66	7.20	47.46	1233.96	487.24
BE	71.00	6.97	64.03	1664.78	918.06
F1	40.00	2.90	37.01	946.60	217.88
F2	55.66	6.48	49.18	1278.68	531.96
F3	68.22	9.82	58.40	1518.40	771.68
F1BA	50.11	5.72	44.38	1154.14	407.42
F1BB	34.88	3.95	30.93	804.18	57.46
F1BC	49.33	5.23	44.10	1146.60	399.88
F1BD	70.00	9.62	60.38	1569.88	823.16
F1BE	54.88	7.96	46.92	1219.92	473.20
F2BA	59.11	4.73	54.38	1413.88	667.16
F2BB	75.11	8.97	66.14	1719.64	972.92
F2BC	84.11	7.99	76.12	1979.12	1232.40
F2BD	82.66	9.98	72.68	1889.68	1142.96
F2BE	57.44	8.16	49.28	1281.28	534.56
F3BA	43.88	4.56	39.32	1022.32	275.60
F3BB	50.00	8.02	41.98	1091.48	344.76
F3BC	34.66	2.78	31.88	828.88	82.16
F3BD	45.77	4.38	41.38	1076.14	329.42
F3BE	57.88	8.66	49.22	1279.72	533.00
Control	47.44	18.72	28.72	746.72	Nil

*BA= NIG-T287
BB= NIG-T288
BC = NIG-T289
BD = NIG-T290
BE = NIG-T293
F1 = Ridomil Gold
F2 = Funguran OH
F3 = Copper Sulphate
F1BA = Ridomil Gold+NIG-T287
F1BB = Ridomil Gold+NIG-T288
F1BC = Ridomil Gold+NIG-T289
F1BD = Ridomil Gold+NIG-T290
F1BE = Ridomil Gold+NIG-T293

F2BA = Funguran OH + NIG-T287
F2BB = Funguran OH + NIG-T288
F2BC = Funguran OH + NIG-T289
F2BD = Funguran OH + NIG-T290
F2BE = Funguran OH + NIG-T293
F3BA = Copper sulphate + NIG-T287
F3BB = Copper Sulphate + NIG-T288
F3BC = Copper Sulphate + NIG-T289
F3BD = Copper Sulphate + NIG-T290
F3BE = Copper Sulphate + NIG-T293

Control= unsprayed stands

*Treatment effect= Bean yield of the treatment - Bean yield of the control

Source: Adedeji et al. 2010

Table 4: Expected Revenue per kilogram as affected by Treatment Applications

Treatment	Cost (₦)	Revenue (₦/K/g)	Revenue-Cost-ratio
*BA	5,400.00	138,223.84	25.60
BB	5,400.00	128,606.40	23.82
BC	5,400.00	68,023.80	12.60
BD	5,400.00	131,554.80	24.36
BE	5,400.00	247,876.20	45.90
F1	5,000.00	58,827.60	11.77
F2	4,400.00	143,629.20	32.64
F3	3,000.00	208,353.60	69.45
F1BA	5,450.00	110,003.40	20.18
F1BB	5,450.00	15,514.20	2.85
F1BC	5,450.00	107,967.60	19.81
F1BD	5,450.00	222,253.20	40.78
F1BE	5,450.00	127,764.00	23.44
F2BA	5,350.00	180,133.20	33.67
F2BB	5,350.00	262,688.40	49.10
F2BC	5,350.00	332,748.00	62.20
F2BD	5,350.00	308,599.20	57.68
F2BE	5,350.00	144,331.20	26.98
F3BA	5,300.00	74,412.00	14.04
F3BB	5,300.00	93,085.20	17.56
F3BC	5,300.00	22,183.20	4.19
F3BD	5,300.00	88,943.40	16.78
F3BE	5,300.00	143,910.00	27.15
Control			

*BA= NIG-T287
BB= NIG-T288
BC = NIG-T289
BD = NIG-T290
BE = NIG-T293
F1 = Ridomil Gold
F2 = Funguran OH
F3 = Copper Sulphate
F1BA = Ridomil Gold+NIG-T287
F1BB = Ridomil Gold+NIG-T288
F1BC = Ridomil Gold+NIG-T289
F1BD = Ridomil Gold+NIG-T290
F1BE = Ridomil Gold+NIG-T293

F2BA = Funguran OH + NIG-T287
F2BB = Funguran OH + NIG-T288
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F2BD = Funguran OH + NIG-T290
F2BE = Funguran OH + NIG-T293
F3BA = Copper sulphate + NIG-T287
F3BB = Copper Sulphate + NIG-T288
F3BC = Copper Sulphate + NIG-T289
F3BD = Copper Sulphate + NIG-T290
F3BE = Copper Sulphate + NIG-T293

Control= unsprayed stands

Source: Adedeji et al. 2010

Food Security through Integrated Disease Management

Food security can generally be said to be a combination of adequate food availability and food access. It was once defined as "when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (World Food Summit 1996). Food security is an important issue considered to be the responsibility of all stakeholders.

Plant pests and diseases are generally known to pose major threats to food safety and security. They are known to reduce production and quality of food, fiber and biofuel crops. Their effects can be more catastrophic when farms are a long way from markets with very poor infrastructure and supply chain practices. Both field and postharvest diseases have been reported to cause huge losses of different crops at different times in history. Such devastation by plant diseases, which had caused famine at one time or the other in certain parts of the world, can be far-reaching in its effect on food security. In the past, millions of people have been reported to die of starvation as a result of the devastating effects of plant diseases on yields of staple crops. Millions have also been reported to emigrate from their countries for similar reason. These yield losses as a result of crop diseases have made some communities become dependent on imported foods, often replacing a balanced diet with processed foods that create further health problems. Presently, the threat posed by plant diseases to food security is particularly great in developing countries where poverty is endemic and populations are growing at an alarming rate with the same population depending solely on locally produced staples.

Food security is not only defined by availability of crops but also by their safety level. It also means that all agro-products, as much as possible, should be free from pesticide residues. There have been reports of crops with different pesticide residues posing dangers to consumers. Many pathogens, especially postharvest, are also known to produce

toxins in several crops thereby compromising the safety status of such crops. This has created very serious health problems for consumers, man and livestock alike.

The potential of a single control method to significantly reduce pest or disease population has been reported to be minimal. No single disease control method can thus be said to guarantee food security and safety. Farmers worldwide in times past had spent billions of dollars on single disease management which aimed at improving food security by reducing crop losses. However this was often with the resultant food safety not commensurate with such a huge spending. Therefore, Integrated Disease Management (IDM) approach holds the most effective promise in that it combines all the available disease control methods by the most economical means with the minimal possible hazards to life and the environment. Though a lot still needs to be done with regard to global food security, it could be said that the world would have faced a crisis of untold global food shortage if plant diseases were not tackled headlong via the use of integrated disease control measures. This is because in the course of IDM, all aspects of crop and farm managements are closely monitored. Indeed the primary concern of every aspect of IDM is food security and safety.

Agriculture in whatever form, in any part of the world, aims to provide food security. It has been reported that global food production must increase by 50% to meet projected demand of the world population by 2050. This goal may be herculean if crop diseases are not tackled using an integrated management approach.

Concluding Remarks and Recommendation

Mr. Vice-Chancellor Sir, distinguished ladies and gentlemen, I have in the last couple of minutes tried to discuss the importance of plant disease management by non-chemical methods and how these methods by integration can increase food production and food safety, which will reduce hunger in our nation. These research activities have been central to my sojourn in this University. I have examined the concept of

Plant Disease and Integrated Plant Disease Management by way of discussing the research efforts on how to reduce pathogen damage on our crops which may be a better option for food safety and security. I have been able to demonstrate by research that these non-chemical approaches to disease control are effective, cheaper and feasible if they can be harnessed.

Mr. Vice-Chancellor Sir, I hereby make the following recommendations.

1. We should develop a curriculum in Phytomedicine just as we have for Veterinary Medicine and Human Medicine. This can be a five-year joint programme which may be housed in the Faculty of Agriculture. The programme will be basically on plant health.
2. We should find a way whereby our Agricultural Extension officers will be more equipped with practical IDM procedures, and more alert to their duty of disseminating research findings on plant health to farmers.
3. The Government should set up a team to deliberate on how the research findings on the non-chemical methods of plant disease management can be utilized, such as setting up companies for commercial production of mycorrhizae inoculants and formulated powders. Other antagonistic microorganisms such as *Trichoderma,* bacteria, etc, can also be constituted into phytofungicides to be commercially produced for farmers.
4. More funds should be made available for research in Basic Sciences such as Botany, Zoology, Microbiology, Chemistry, Physics and Mathematics which are the bedrock of Applied Sciences, knowing that most of the Nobel prizes in Medicine and Engineering are won by researchers from Basic Sciences.
5. The Government should look for a way of establishing a synergy between the Federal Agricultural Research Institutes and the Universities for

effective collaborations in their research activities to promote better food security in the country. Hopefully this will also reduce wastefulness in research spending, rancour that occur in appointment of executive directors, rivalry and disparity that is among research institutes and the universities.

6. Finally, the Government should as a matter of priority provide an enabling environment to do research, in terms of equipment, grants and power (electricity). This investment will produce quality research outputs from our universities.

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'Come thou fount of ev'ry blessings;
Tune my heart to sing thy grace;
Streams of mercy, never ceasing;
Call for songs of loudest praise;
Teach me some melodious sonnet;
Sung by flaming tongues above;
Praise the mount- I am fixed upon it
Mount of thy redeeming love'

Mr. Vice-Chancellor Sir, distinguished Ladies and Gentlemen, "Hitherto the Lord has helped me (Ebenezer)". I thank you all.

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BIODATA OF PROFESSOR ADEGBOYEGA CHRISTOPHER ODEBODE

Adegboyega Christopher Odebode was born to the Family of Late Pa Samuel Adegbite and Mama Christiana Wuraola Odebode of Age Compound, Awe, in Lagos over sixty years ago. He attended Christ Baptist day School Awe, where he obtained the First School Leaving Certificate Grade A. He later attended Awe high School and Baptist Academy Lagos where he passed his West African School Certificate Examination in Division II. He worked briefly with Nigerian Security and Printing Company in Victoria Island Lagos before joining the Nigeria Customs Service where he left in 1971. As usual in those days being in search of the golden fleece, he travelled to Freeport, the Bahamas, West Indies. In 1973, he was admitted to Northern Virginia Community College, Alexandria, Virginia, United States of America, where he excelled and was on the Dean's Honor's Roll. After 2 years in the college, he proceeded to Catholic University of America Washington D.C, U.S.A, where he had his Bachelor of Art degree in Biology in 1978. Between 1978 and 1980, he attended Howard University, Washington D.C, U.S.A where he obtained his M.Sc degree in Botany (Mycology Option). He returned home in January, 1981 and had his National Service at Lagos State Technical College Ojoo, Lagos State.

Professor Odebode was employed as a Research Officer I by Cocoa Research Institute of Nigeria (CRIN) Idi-Ayunre, Ibadan from 1982- July 1990, after which he joined the University of Ibadan as an Assistant Lecturer. While in CRIN, he embarked on his Ph.D programme in Plant Pathology in the Department of Botany from 1985 to 1990. He successfully completed his Ph.D program in November 1990 and was upgraded to the post of Lecturer II. He was promoted to the grade of Lecturer I in October, 1994; Senior Lecturer in October, 1997, Reader October, 2002 and Professor in October, 2007.

Professor Odebode has supervised over 40 M.Sc dissertations, 13 Ph.D theses in Plant Pathology and Mycology and several B.Sc students' projects. He has published over 90 Scientific articles in reputable national and international Journals. He is a Fellow of Science Association of Nigeria (SAN), and a trustee of the Phytopathology Society of Nigeria (PSN).

Professor Odebode has held a number of administrative positions in the University. He served as Assistant Warden of Sultan Bello Hall for 6 years (1993 to 1999) and later became the Warden (2003 to 2004). He was Ag Head, Department of Botany and Microbiology (2004-2006). Ag Head and later Head of Department of Botany from 2010 till date.

He has served as External Examiner to University of Lagos, Federal University of Agriculture, Abeokuta, Obafemi Awolowo University, Ile-Ife, Olabisi Onabanjo University, Ago-Iwoye, Tai-Solarin University of Education, Ijebu-Ode, Federal University of Technology, Akure, Ekiti State University, Ado-Ekiti, University of Agriculture, Makurdi, Ahmadu Bello University Zaria and Usman Danfodio University, Sokoto.

Professor A.C. Odebode is an Evangelist and Ordained Baptist Minister. He is married to his hearthrob, Mrs. C.A. Odebode and blessed with children and grandchildren.

NATIONAL ANTHEM

Arise, O compatriots
Nigeria's call obey
To serve our fatherland
With love and strength and faith
The labour of our heroes' past
Shall never be in vain
To serve with heart and might
One nation bound in freedom
Peace and unity

O God of creation
Direct our noble cause
Guide thou our leaders right
Help our youths the truth to know
In love and honesty to grow
And living just and true
Great lofty heights attain
To build a nation where peace
And justice shall reign

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Unibadan, Fountainhead
Of true learning, deep and sound
Soothing spring for all who thirst
Bounds of knowledge to advance
Pledge to serve our cherished goals!
Self-reliance, unity
That our nation may with pride
Help to build a world that is truly free

Unibadan, first and best
Raise true minds for a noble cause
Social justice, equal chance
Greatness won with honest toil
Guide our people this to know
Wisdom's best to service turned
Help enshrine the right to learn
For a mind that knows is a mind that's free