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PLANT PATHOLOGY IN GHANA: PAST, PRESENT AND FUTURE

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Summary

The paper reviews the development of plant pathology in Ghana. The period under review is divided into the past (pre-independence), the present (post-independence) and the future. The past, starting from 1914 officially marks the birth of plant pathology in Ghana (then Gold Coast) with the arrival of the British mycologist, R. A. Bunting, who was later joined by other expatriate mycologists. Bunting and his colleagues identified some diseases (usually of fungal aetiology) and enforced disease control measures with the help of the colonial Government. The first plant pathology book entitled *Gold Coast Plant Disease,* published in 1925, was authored by H. A. Dade and R. A. Bunting. The present period is characterized by increased awareness of plant diseases as well as an increase in the number of trained local plant pathologists/mycologists. Some new diseases were subsequently identified and published locally. The science of plant pathology in Ghana is still confronted with a number of problems despite progress made so far in the field. These include inadequate aetiological studies on some diseases, inadequate control of some important diseases, introduction of foreign disease and poor interaction among Ghanaian plant pathologists. These problems are discussed and suggestions for future work made.

Introduction

Plant diseases constitute a major constraint to crop production often resulting in a great degree of crop losses which may range from slight to 100 per cent (Agrios, 1969). Fossil studies suggest that plant diseases are so old as the plants themselves. However, the first available records of plant diseases appear in the Old Testament of the Bible (Deutronomy 28:22). In these writings plant diseases were attributed to punishments from God for committing offences.

The study of diseases in plants is termed plant pathology. It involves, among others, the causes (aetiology), development of the disease in the plant (pathogenesis), spread of the disease through a population of plants (epidemiology) and control. The development and establishment of a disease are the culmination of events occurring between a susceptible host, favourable environmental conditions and the pathogen.

The tropical humid environment in Ghana is ideal for the cyclical development of plant pathogens and in fact plant diseases are well known in the country. Most Ghanaian cocoa farmers are familiar with the cocoa swollen shoot and black pod diseases which are traditionally referred to as 'kokoo sasaboro' and 'anonom'. Maize farmers still make references to the rust epidemic in the 1950s and cassava farmers remember the severe outbreak of cassava bacterial blight in the 1970s.

In this review, we present a historical development of plant pathology and discuss some factors, which may have affected the progress of the science in Ghana. The review is divided into (i) the pre-independence period (ii), the post-independence period and (iii) the future.

Pre-independence Period

The period (1890 - 1956) marked the era of colonial administration. Plant pathology was initiated during the period and expatriate scientists arrived in the colony to study and recommend control measures to some of the diseases.

Birth and early development of plant pathology

A Department of Agriculture was set up in the then Gold Coast (Anon., 1980) and specimented disease in the country was the mould disease of

cocoa (*Theobroma cacao* L.). Thereafter, a number of other diseases including pod-rot and wilt of cocoa, root rot of rubber (*Hevea brasiliensis* Wild ex Adr. de Juss), rust of rice (*Oryza sativa* L.) and mould of coconut fruits (*Cocos nucifera* L.) were reported (Anon., 1908; Evans *et al.*, 1909). These reports were only a description of the pathological condition of the crop with no further identification of the causal organism.

Mycological and plant pathological investigations began on a more organized basis after the arrival in the Gold Coast of the British mycologist, R. H. Bunting in 1914 (Anon., 1919). Following the construction of a temporary mycological laboratory at Aburi (Eastern Region of Ghana), more scientists were invited to research into various aspects of plant pathology. Notable among these were H.A. Dade, F. C. Deighton and R. I. Leather. Bunting and his colleagues focused on taxonomy of the causal fungi and symptomatology of diseases such as black pod of cocoa, rust of coffee (*Coffea arabica* L.) and smut of maize (*Zea mays* L.). Control measures, largely based on experience gained in other countries were recommended by these scientists.

The establishment of the West African Cocoa Research Station in 1938 at Tafo (Eastern Region of Ghana) was a significant development in plant pathology in the country. Firstly, sufficient funds were provided for promoting research, some of which was on plant diseases and secondly, more trained and qualified scientists (all expatriates) became available in the country. Much attention was given to the diseases of cocoa, the main export crop of the colony. Major areas of research were the aetiology, ecology and control of collar crack and the black pod diseases of cocoa (Dale, 1962); Wharton, 1960).

The characteristics swollen shoot symptom of cocoa was observed and reported by farmers in 1920 (Dale, 1962), but was first recognized as a disease in 1936 (Steven, 1936). The disease was subsequently shown to be caused by a virus and named the cocoa swollen shoot virus disease (Posnette, 1940). The disease was very devastating and of great concern to the government. Annual yield loss of crop in the Eastern Region of Ghana was estimated at 120,000 tonnes (Hale, 1953). Regular inspection of cocoa trees, cutting out of visibly infected and contact trees were recommended for the control of the swollen shoot disease (Broatch, 1953; 1955; Moss, 1953).

Studies to identify varieties of crop plants with marked resistance to plant diseases were also initiated. Dade (1930) screened varieties of cassava (*Manihot esculenta* Crantz) available in the country and concluded that, two local varieties - 'banche sereso' and 'calabar' were relatively resistant to the cassava mosaic virus disease. Epidemiological studies were also undertaken to monitor the spread of some of the important diseases occurring in the country. Notably among these were tristeza dieback of citrus and the Cape St Paul wilt of coconut (Leather, 1959a, 1959b).

The Colonial Government Policy on Plant Disease Control

Under the colonial government, the Department of Agriculture played a vital role in the control of plant diseases. Extension workers periodically visited farmers to advise them on appropriate management practices. Demonstrations and other visual aids were used and/or applied to educate the farmers on effective control measures to be adopted. However, these recommendations were only implemented by a few of the cocoa farmers. Most of them abandoned their farms when they became seriously attacked by diseases because they were not satisfied with the prices offered by the government for their produce (Anon., 1924).

The colonial government subsequently enacted bye-laws and ordinance under the 'Native Jurisdiction Ordinance'. These bye-laws empowered local chiefs to impose a fine on farmers who abandoned their farms as a result of disease outbreak on failed to report any new disease outbreak to extension officers (Anon., 1924). Some of the farmers complied with the bye-laws because of fear of imprisonment resulting from inability to

pay the fines. However, majority of them, whose farms where located in areas inaccessible to the extension officers ignored the government directive and continued to abandon their farms when they became infected. The infected plants in the abandoned farms served as sources of inoculum for the spread of the diseases into new areas (Anon., 1924).

Restrictions on importation of plant materials were also imposed under the ordinance. Plant material could only be imported into the country following prior certification by the Director of Agriculture (Tudhope, 1911; Anon., 1924).

Early publications and reports

The main publication during this era was a book entitled *Gold Coast Plant Diseases* and authored by Bunting & Dade (1925). It gives a summary of most of the diseases prevalent in the colony and suggests their methods of control. Other information relating to plant diseases were published as annual reports of the Department of Agriculture and in the Gold Coast farmers' reports.

Post-Independence Period

The period from 1957 to date is characterized by an increased awareness of plant diseases as evidence by the upsurge in research in plant pathology and by the number of trained local plant pathologists. Training of middle level personnel in plant pathology has also been given attention and there has been comparatively greater turn out of published literature on plant diseases. Some of the new techniques in molecular biology are also being applied in diagnosis and characterization of strains of plant pathogens.

Major diseases and research activities

By 1965, the number of plant diseases reported in Ghana had increased from 76 (Bunting & Dade, 1925) to 230 (Chona, Addoh & Addison, 1965). Since then, more new diseases have been reported. Nine new diseases were reported at the 11th Biennial Conference of the Ghana Science Association in 1979. The list included some important diseases as cassava bacterial blight and sugarcane smut (Oduro, 1979).

Intensive research was initiated into diseases that affect cocoa because it is a major export crop of the country. The virus-causing the swollen shoot disease was purified and electromicrographed (Brunt, Kenten & Nixon, 1964, Kenten & Legg, 1971; Adomako, Leseman & Paul, 1983) and the genomic components and structure of the virus were established (Uhde *et al.*, 1993). Current studies include the application of ELISA and virobacterial agglutination (VBA) in the detection of the virus in infected plants (Hughes & Ollennu, 1993).

Despite the efforts to control the cocoa swollen shoot disease over the years, it continues to spread to new areas and could cause as much as 60 per cent reduction in yield (Blencowe & Brunt, 1962); Brunt, 1975). The disease has become endemic in some cocoa-growing areas and appears impossible to control (Hughes & Ollennu, 1994). The traditional method of control by eradicating infected and contact trees is becoming ineffective, expensive and socially unacceptable (Ollennu, Owusu & Tresh, 1989). The need for a more efficient means of control cannot be overemphasized. The use of mild strain protection technique, as a possible means of controlling the disease is currently being investigated (Hughes & Ollennu, 1994). However, although mild strain protection appears an attractive method, a number of other related factors would have to be investigated before it could be applied.

Black pod disease is one of the important diseases of cocoa. Losses caused by the disease could reach 36 per cent (Blencowe & Wharton, 1961) and the disease is probably present on all cocoa farms (Darkwa, 1986). Recent devastating outbreaks of infection have been attributed to a new strain of *Phytophthora* called *P. megakarya* (Darkwa, 1986). Fragment length polymorphism is being applied to elucidate the genetic identities and relatedness of the two *Phytophthora* strains (Anon., 1992). Information generated from the research about the genotypes of the pathogen

would be useful in developing genetic probes for easy identification and probably control of the disease.

The Cape St Paul wilt disease of coconut has caused extensive losses in recent years and poses a threat to coconut production in the country (Eden-Green, 1995). Although the disease has been present in Ghana since 1932 (Leather, 1959a), it assumed epidemic status in recent years in the coconut growing areas of Ghana. Large acreages of coconut plantations have been devastated and many coconut farmers have lost their livelihoods. The incubation period of the disease is about 3 - 12 months and by the end of this period, the coconut plant is completely destroyed. A mycoplasma-like organism (MLO) reported associated with the disease (Dabek, Johonson & Harries, 1976) has been confirmed recently (Harrison *et al.*, 1992). Trials have been initiated to identify coconut varieties resistant to the disease and these trials are beginning to yield some information about the susceptibility of different coconut lines to the disease (Eden-Green *et al.*, 1994a). Disease specific polymerase chain reaction (PCR) techniques have now been developed and are being applied in vector identification studies (Eden-Green, Tymon & Offei, 1994b).

Sigatoka disease of banana caused by *Mycosphaerella fijensis* has in recent years become very widespread and devastates many plantain plantations in Ghana. A team of scientists was commissioned by the Government of Ghana to assess the extend of spread and conduct studies designed to control the disease (Oduro *et al*, 1992).

Other studies undertaken during the period under review include a search for resistance to nematode diseases (Edwards, 1956; Peacock, 1957; Sinnadurai, 1973), epidemiology of cassava bacterial blight (Korang-Amoako, 1977; Korang-Amoako & Oduro, 1978) and virus diseases of legumes (Thottapilly *et al.*, 1995).

Training in plant pathology

Limited facilities are available in most academic and research institutes for training and for conducting research in most of the basic aspects of plant pathology. A number of scientists have been trained and they now have expertise in various aspects of plant pathology. Most of these researchers had part of their training in Ghana and part abroad in their specialized areas. Plant pathology courses have also been introduced at most levels of the country's educational system where agriculture or botany courses are taught. Undergraduate students in the universities majoring in crop science or botany have the option to specialize in crop protection and conduct their project work in plant pathology. Few students, however, have pursued plant pathology to the post-graduate level in Ghana.

Publications

A bulletin entitled "Diseases of economic plants other than cocoa" authored by Leather (1959b) was an updated version by Bunting & Dade (1925) and contains control methods for most of the diseases. Information on plant diseases have been complied by Dale (1962), and Wharton (1962). Piening (1962) compiled an exhaustive list of saprophytic and pathogenic fungi occurring in the country. Perhaps, the most commendable publication in plant pathology in Ghana is a book by Clerk (1974) entitled *Crops and their diseases in Ghana*. It is the first basic textbook on plant pathology in Ghana and has a large usage.

The Future

Plant pathology has made significant progress in Ghana, since its inception in the country. With the new trend in the nation's agricultural programmes, where large scale monocrop farming and artificial overhead irrigation schemes are being applied, it is envisaged that plant pathology would play a more important role in the future. It would, therefore, be expected that all the applied and basic aspects of plant pathology would be given equal emphasis in order to meet demands which are likely to arise in the future.

Forecasting of plant diseases in Ghana has been

given little attention despite the importance of such information in the control of most of the important disease in the country. The development of a good and reliable forecasting system for important diseases would be essential in formulating effective management systems. Adequate information on the epidemiology of most plant diseases occurring in Ghana have been accumulated. These pieces of information could be processed to develop reliable models to predict outbreaks and spread of these diseases. Adequate funds would have to be committed to such endeavours.

Facilities for local training of scientists and for research in plant pathology have been very limited. This has greatly affected the scope and depth of investigations that have been conducted. Although scientists with expertise in most aspects of plant pathology are available in the country, most students have had to travel overseas to complete their studies partly because of the poor state of facilities and equipment for phytopathological research in the country. Nematology, for example, is one of the least developed aspects of plant pathology in Ghana and little emphasis is placed on the subject in the carricula of most academic institutions.

There are certain important crop diseases whose aetiology have not been conclusively established. Symptoms indicative of banana streak and cucumber mosaic virus infections have been reported by local plantain farmers. Similarly, symptoms indicative of virus infections have been observed on crops such as yam, cocoyam and sweet potato. Investigations at the early stages of these diseases would be necessary to prevent serious epidemics in the future. Infected seeds are one major source of introduction of disease into the field. The pathogens become established early in the cropping season and are capable of surviving for a long period in the seed. Unfortunately, seed certification has not been given much attention in most national agricultural programmes despite its importance in the control of plant disease .

Development of plant pathology in Ghana in the future should consider a greater application of some of the latest technology in the study and control of plant diseases. Although this may be expensive in the short term, it is likely to provide a long term solution and would become more cost effective in the future. The technology could be used in developing alternative control measures for diseases such as the swollen shoot and black pod diseases of cocoa for which the traditional cutting out is still being implemented (Anon., 1995). With information on the structure of some of the important pathogens now available, serious consideration and effort must be put in the use of molecular biology techniques, in the analysis of these diseases. These would not only be useful in understanding the disease complex, but would also be necessary in the development of more effective and perhaps permanent control programmes.

Interaction among local plant pathologists has been on a very limited scale. Each pathologist appears to work independently and there is hardly any exchange of ideas. The formation of a society of plant pathologists, as exists in other countries, could help overcome this situation. Plant pathologists can then meet to discuss issues related to the science, and co-ordinate their activities more effectively.

Literature on plant diseases in Ghana is limited. Most of the publications in plant pathology have been on fungal diseases, although diseases caused by other pathogens do exist and could result in severe reductions in yield. Although some pieces of information exist in annual reports of some of the research and academic institutes, these are not readily available. A catalogue of plant diseases existing in the country would be important in formulating research projects and developing management strategies for these diswhich phytopathological information is published in Ghana.

Lack of funds, inadequate research facilities and dearth of trained personnel to assist laboratory work in plant pathology have adversely affected advancement of the science in the country. Some

of the phytopathological research programmes initiated in the colonial era had been abandoned owing to any or a combination of the above factors. In order to make significant progress in our agricultural programmes, plant pathology would have to be considered as one of the important components of these programmes.

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