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ERRATA

Page 11, Fig 2, Nephrolepis undulata
Page 11, Fig 2a, should read "Young Plant"
" 11, Fig 2b should read "Undersurface of fertile pinna."
" 34, line 7, should read "Colletotrichum"
" 39, No: 8 (down) should read "pathogen" not pathgen.
" 62, line 1, should read "resistant" not resistance.
68, line 3, should read "Fusarium"
" 68 (a) should read "indiscriminate"
" 68 (b) should read "burning".

EDITORIAL COMMENT

It is exactly one year now, that the first volume of the Botanical Society's Journal - EUPHORBIA was launched. Since then series of letters containing suggestions and criticisms have been mailed to us from some of our readers. These have been carefully looked into and followed during the process of making this volume and we hope you will enjoy it.

EUPHORBIA is an annual scientific journal of the Botanical Society, University of Jos which primarily serves as a communication medium between the staff and students of the Botany Department on one hand and the general reading public, on the other hand.

In this issue emphasy is focussed on the role of Botany in the development of agriculture especially as it affects Nigeria. Articles were received from men and women of intellect both within and outside the University community. I hope this publication will provide the informational basis for the stimulation of innovation and improvement in the teaching and study of Botany..

The Editorial Board owes it as a duty to thank those people who are responsible wholly or partially for the successful production of the academic journal. These include the Head of Botany Department, Professor G. K. Berrie who is also the Grand Patron of the Society for his moral and financial support and encouragement, Drs. C. O. Akueshi and C. P. Sreemadhavan for their precious advice and the former editor, Mr. E. A. Ataga for laying good precedent. Special thanks to all our lecturers and other contributors.

I wish you all the best of luck, and happy reading.

FAPOHUNDA Stephen Oyedele

GRAND PATRON'S MESSAGE

by

Professor G K Berrie
Head of Botany Department and Deputy Vice-Chancellor

It is my pleasure to present this Grand Patron's Message for inclusion in the second issue of Euphorbia, the periodical published by the Botanical Society of the University of Jos. The first issue was of very high quality and I have no doubt that this second issue is the same.

As I have already said under less formal circumstances, I find myself very impressed by the enterprise shown by successive executives of the Botanical Society and no less impressed by the support given by the members to functions organized by the Society. I see this support as indicating a true interest in the subject of Botany. It is only through such whole-hearted interest that the subject may develop and flower to the fullest extent. The clear evidence for such interest is a very good omen for the future of the study of Botany at this University.

We had a very successful Botanical Day in the Session 1977/78. The quality of participation in the function was high and the appreciation shown by participants and guests was manifested both verbally and financiall[y]. The Society must be specially appreciative of the support of that prominent Jos personality, Mr. Jack Tilley-Gyado Prizes for Botany. These prizes are for award to Botany students on the basis of their performance in the third-year examinations. The first set of prizes is expected to be formally awar[ded] at our first Convocation, later this month. Mr. Jack Tilley-Gyado is, of course, a botanist. His present profession is not a botanical one and his continued, deep interest in the study of Botany must be taken as a shining example to us all. It is also an indication of the unbreakable fascination of the subject for those who have been initiated.

Let me conclude this message by wishing that the Botanical Society and the Department of Botany may, hand in hand, go from strength to strengt[h] in 1979 and in years to come.

FROM THE PRESIDENT'S DESK

It is with great pleasure that I give the presidential message on the occassion of the publication of Volume II of our annual journal "EUPHORBIA." The journal, which was first published last year as a medium for students and lecturers of this University to communicate the roles and contributions of the study of Botany in the society to the public, have come to stay. This has been made possible by the determination of the members of the Society to establish self-actualisation.

Since the last publication of this journal, the Society has recorded lots of achievements which have projected it to the top amongst academic associations in this University. Last year, the society introduced an annual "BOTANICAL DAY" in which activities like symposium, science exhibition, interdisciplinary debate, etc. were organised. This year's celebration hopes to include new activities like science quiz competition for secondary schools in Jos and its environ, Miss BOTANY competition and film show. The Society's termly public lectures continue to dominate the campus and the terminal Newsletter of the Society is yet to be equalled by any other academic association.

The members of the Society have continued to display their sense of duty and initiative to the Society. This they have extended to the general student body. There is no single organisation on this campus in which a Botany student is not a major force to be reckoned with. This has contributed in no small measure to the intellectual and social upliftments in this young, growing University. I hope our members will continue to play active roles in students activities.

The staff/students relationship in the Department has been most cordial and continue to serve as inspiration and encouragement to the students. This cordality and peaceful atmosphere can be attributed to the cooperative and fatherly understanding of our lecturers, whom our success is upper-most in their minds. I hope this good staff/student relationship will ever remain with us.

I must not end this message without highlighting some of the short-comings of the Society. Students participation in the Society's activities is fast deteriorating. This is mostly due to the passivity and I-don't-care attitude of our female members and students in the lower classes. I hope they will not allow the high standard already attained by the Society to fall. The Society has not been able to undertake extensive tour to research stations, rainforest and mangrove vegetation in the southern part of the country. The one scheduled for last year April was cancelled because of non-availability of transport. I hope the Society will be able to embark on this tour in no distant future.

Before I end this message I wish to thank and congratulate my predecessor, Mr. Kola Odunlami for projecting the Society to such a great height regardless of the odds against him. My special thanks go to the Head of Department, Professor G. K. Berrie for his support; our life patron Mr. Jack Tilley-Gyado for his financial and moral support; and my thanks also go to the lecturers and members of the Society.

To the reading public, I hope you will find this second edition of the "EUPHORBIA" both interesting and educating. And if I may quote Harold Saunders "To wrest secrets from nature and to gain wisdom, man needs both knowledge and a kind imagination. If the first is increased and the second stimulated, the underlying purpose of this journal will have been served"!

Happy reading and long live BOTANICAL SOCIETY? UNIJOS.

ATAGA EROMOSELE ANTHONY
President
1978/79 Session.

PLACE OF PLANT TO THE SUCCESS OF MODERN MEDICINE

by

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Ever before the development of human culture there had been what is termed close relationship between man and the plants around him. But it should be understood that at no time in the development of mankind, however, has there been more rapid and more deeply meaningful progress in our understanding of plants and their chemical constituents than during the past quarter century. This aroused some curiosity especially in view of somewhat earlier depreciation in pharmaceutical chemistry of any emphasis on plants.

Towards the end of 19th Century the gradual sophistication of phytochemistry and the massive exaggeration of hope for specific remedies from vegetal sources any and all ills set up a counter-current and a tendency to disparage any data concerning the potential vclue of physiological active plants. With the work of synthetic chemists, the potentialities of plant kingdom were sloughed off without ceremony.

The discovery of the so called "Wonder Drugs" nearly all from vegetal sources sparked off a revolution. Inspite of this, it remained crystal clear that the plant kingdom represents a virtually untapped reservoir of new chemical compounds, many extraordinarily biodynamic, some providing novel bases on which the synthetic chemists may build even more interesting structures. From this first and second decades the most startling effective drugs discovered, scattered throughout the plant kingdom. They range from the muscle relaxants from South American arrow poisons, antibiotics from moulds, actinomycetes, bacteria, lichens and other plants; rutin from a number of species; cortisone precursors from sapogenius of several plants especially from Strophanthus and Dioscorea; hypentensive agents from Veratrum, reserpine from Ranwolfia and many others - not to mention the numberous psychoactive structures of potential values in experimental psychiary, some new, some old, from many cryptogamic and phanerogamic sources.

Another thing done hand in hand with the vegetal discoveries is new methods of testing and refined techniques which have led to the finding of novel uses of older drugs. In 1960, excluding antibiotics and steriods it was reported that over 17% of American prescriptions used one or more kinds of plant products - either produced directly from plants or discovered from plant sources and later synthesized. A more up-to- date analysis of American prescriptions covering over one billion, written in 1967 gave the following breakdown: 25% contained principles from higher plants; 12% were microbial derived products; 6% were animal derived substances; 7% had minerals as the active ingredients; 50% of the active principles were synthetic.

It is important to note that this organised grand advancement in our understanding of the distribution of organic vegetal compounds has resulted not only from the organised research on the part of botanists, chemists and pharmocologists alone but also from other fields of study like anthropology, archaeology, comparative religion, and other specialists. This intertwining of data and points of view from sundry fields has often been called ethnobotany or, in respect of drug plants, ethnopharmacology.

Many ways have been applied in search for new biodynamic plant constituents. The most method being random or semi-random screening of plants. This method is in fact expensive both in time and money but proved most successful in recent years. The principal constituents in search being alkaloids, saponines, flavonoids, etc. Perhaps one of the most ambitious random searches has been the screening of plants for possible antineo-plastic activity by the Cancer Chemotherapy National Service Centre which has tested more than 26,000 plant extracts representing some 6,500 species.

Another approach centred on intensive investigation on plants with folk uses reported in both ancient and modern literature. Ethnobotanical literature goes back 3700 years to the code of Hammurabi. This might mean foolish to many specialists, yet it gave clues to the discovery of more information about the vegetal ingredients. Had ethnobotanists critically evaluated the writings of the Egyptian/Papyri, the might not have had to wait until the 1940's for an acquaintance with the antibiotic properties of certain fungi. A Dutch botanist of the 17th Century, Rumphius, for example, whose work was basic to the natural history of the East Indies, accumulated notes on folk uses of more than 700 species of plants. Insisting on verifying personally whenever possible what natives reported, he nonetheless wrote down what he considered facts as well as hear-says.

The writings of naturalists and others of the new world, some still in manuscript form - are replete with yet unverified reports of therapeutic and biodynamic values of plants. In some cases, the specific identification of the plant is relatively easy. This approach, though atimes frustrating because of the casualness of diagnosis of specific ills or, more commonly, the lack of proper botanical identification of source plants, has been outstandingly, even spectacularly, successful in number of instances. An instance is where folk uses of plants, had been seriously followed up which might have led much earlier to valuable discoveries. The discovery of the use in Mexico and the exact botanical identification of several potent hallucinogens - especially the "Sacred" mushrooms and morning glory - all fully outlined in detail in early historical chronicles and missionary reports, is perhaps the most recent example of ancient folk reporters' having led to significant phytochemical advances.

Now that we can notice that, there are about 50 categories of secondary organic constituents known from the world higher plants alone and that only a small fraction of higher plants have been phytochemically investigated. It is therefore important to ask about the future of the plant kingdom as a source of biodynamic constituents. This question may obviously stimulate further wide open field for research on biodynamic constituents. Very sophisticated modern microtechniques, furthermore, can amplify the horizen attainable by today's phytochemists. Even though it may represent nothing more than guess, I would pin-point that less than 10% of the organic constituents of the Angiosperms are known; approximately 90% remains for investigation and discovery. I would like to emphasize further that the above guess would perhaps not be extravagant when one combines, however, the spectacular advances in the chemistry of secondary organic vegetal constituents with the many pointers provided by modern ethnobotany.

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PLANT COLLECTING IN THE JOS AREA

by

Mrs Audrey Berrie

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Finding specimens to study should be easier for a botanist than a zoologist, Plants do not move around, while animals can sometimes move very fast from one place to another. So a zoologist may have to chase his specimens or trap them before he can study them. The botanist can collect specimens rather less energetically, but it is not always easy to find the particular plants you need.

Any student who has spent a full session at UniJos will know that the teaching period of October to June is largely occupied by the Dry Season. Getting specimens for practical classes can pose quite a problem, especially with materials of the 'lower plant groups' that is, the Algae, Bryophytes and Pteriodophytes.

During my first session in Jos, about December 1976, I was told by some persons that there are no ferns around Jos. We have to collect some from farther south, and we have had specimens for practical classes brought up from Ibadan. Looking around at that time of year, well into the Dry Season, it was obvious that there were no ferns to be collected then, but I remembered seeing some just after arriving in September, so I went looking for them. I did find the plants, or rather the dried up remains of them, dead leaves and dried up leaf bases of the fern, _Pellaea_ sp. on the rocky ground near the UniJos Senior Staff houses on Bauchi Road.

Searching around that area in the dried-up stream bed I also found remains of _Selaginella_ plants, and a dead frond of an _Adiantum_ fern. None of these were any use for botany practical class, and that dry season we were able to purchase two large potted plants of _Dryopteris_ sp. from the Naraguta Nurseries. However in the hope of finding locations of other ferns I used my copy of "The Ferns and Fern-Allies of West Tropical Africa", (this is the supplement to the 2nd Edition of the Flora of W.T.A.), to look up the recorded places of common ferns which I had previously known and collected in and around Ibadan. I found that there are a number of ferns and related plants recorded, but the locations are not detailed enough to find the very place where it may have been collected, for example, many records just say "Jos Plateau", a few say "Vom" or "Naraguta, Jos". At least from this I knew that these plants are found in some places nearby, provided that I look for them at the right time of year. From my very brief sighting of the Pellaca sp. in September, and the finding of the dried-up plants and dead frond in December I decided to start looking again in that place in the next Wet Season. Then, looking at the map of the Jos Plateau and knowing that the wet winds came from the South-West direction, I found from the rainfall figures that places to the S.W. of Jos had just a little more rain than Jos itself. I wondered if there were any sheltered places in the Vom area that still might have living ferns, growing during the Dry Season. So I went exploring, and plant collecting in the Vom area.

Passing through Vom village near the Veterinary Station, there are hills visible a few miles away. These I found to be just behind the Vom Hospital, and on the map they are called the Vom Hills. Here, in the middle of the Dry Season, I found a sheltered gully with a small stream of water flowing and on the very steep sides of the almost bare soil, up to 3 or 5 metres from the water, spreading along the sides of the gully were plants of a fern, Gleichenia linearis. Closer to the water were thalloid bryophytes, Marchantia sp. and Symphy-Symphyogyna sp., and mixed up with these and the Gleichenia were a few plants of Selaginella sp. and Lycopodium cernuum. In fact, this place might almost be called a "fern gully", for my final discovery was of two or three small plants of a Tree-fern, Cyathea sp. and an Osmunda regalis, the Royal Fern. Some of these plants I collected and brought back to put in the Botanical Nursery, and indeed were put on show in our First Botanical Society Exhibition in February 1978.

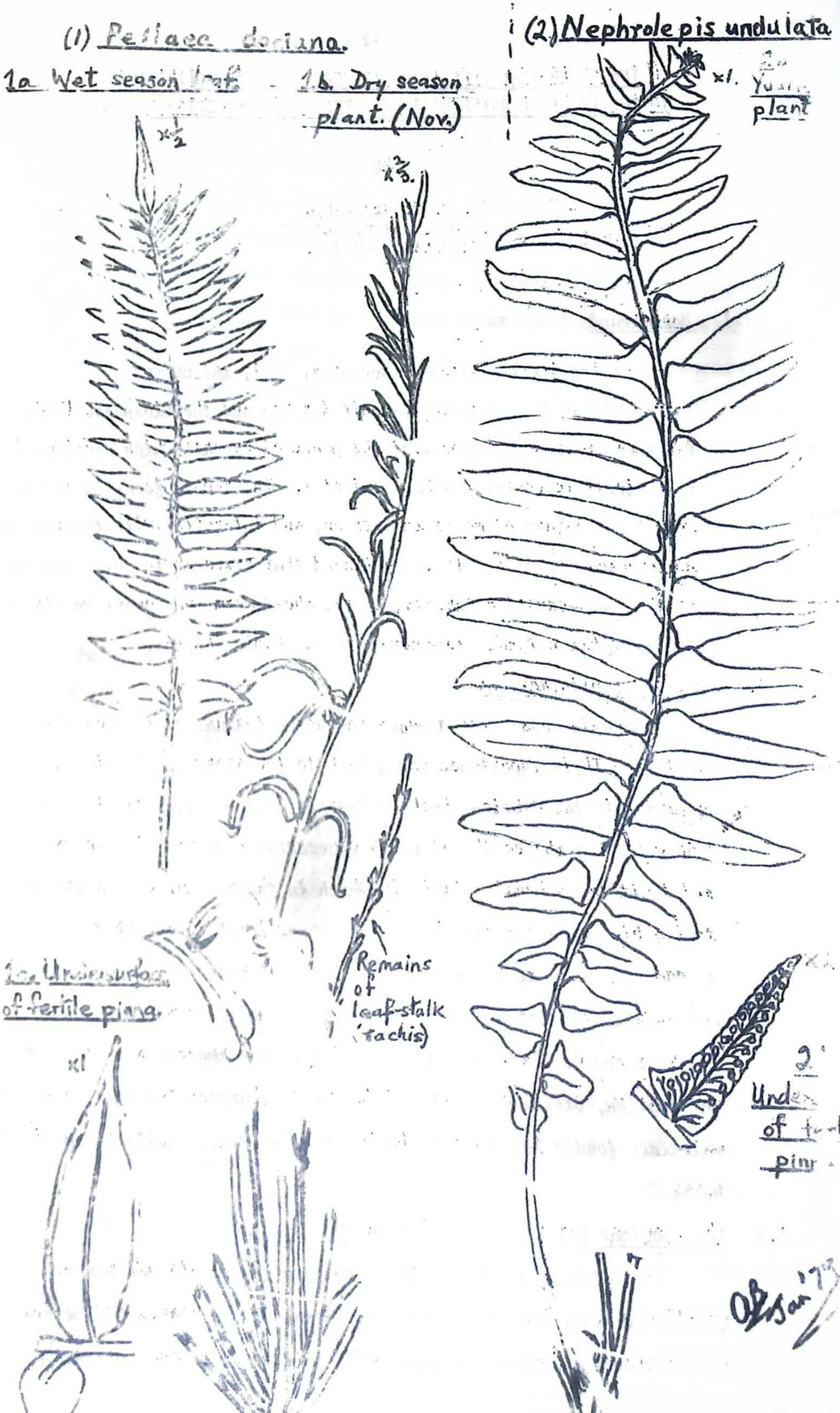
Recently, (Dec. 1978) I have found a similar but smaller sheltered spot along the Dogun Dutse road to the Shire Hills, near the Old Jos Reservoir, were Lycopodium cernuum is growing with Selaginella sp., Dryopteris Sp. and bryophytes.

So it is clear from observations in and around Jos that we do have ferns and related plants growing on the Plateau, but they are not as common as in the wetter areas of the forest regions of the south. The Savannah ferns are conspicuous during the Wet Season. The terrestrial variety of Nephrolepis undulata is very common in the bush along the Bauchi Road between the Science Faculty and the Naraguta Hostels, standing up amongst the grass and very clear seen from the road, even in September. This fern, although dying down completely in the bush during the Dry Season, can be easily kept alive all the year if well watered in the sheltered condition of this Nursery so it is very useful for class purposes.

Other genera of ferns which die down at the end of the Wet Season seem to have a built-in resting period, and will not continue growing even if kept in well watered pots. Such an example is the Ophioglossum caudatum plant- it produces on leaf with fertile spike during the rains and then dies down by October, remaining only as an underground rhizome, with no leaves until the next Wet Season. Any collection of this plant must be done late August or September for good complete specimens. In fact, the best time for collecting most fern plant specimens. In fact, the best time for collecting most fern plants is September. By then they have had a full growing season to produce both vegetative and fertile leaves. Both parts are very necessary for identification of the plants (for Family and Genus), and if the plants are wanted for teaching/practical classes they can be planted in pots and kept well watered in a sheltered place until needed.

So, if you are looking for good specimens of the "lower plant groups" in or around Jos, then remember to look in the right place and at the right time of year; preferably in a sheltered place where the dry winds do not penetrate during the Dry Season, or if in a more open habitat, at the end of the Wet Season, before the plants 'die off' or go into a dormant state surviving only below ground until the next rain comes.

TWO MOST COMMON FERNS OF JOS



THE ECOLOGICAL EFFECTS OF INCREASING HUMAN ACTIVITIES IN THE TROPICAL RAINFOREST ECOSYSTEM - THE NIGERIAN EXAMPLE

by

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1.1 Background

At its first session in November, 1971, the UNESCO International Co-ordinating Council for Man and the Biosphere (MAB) Programme prepared a report of the panel of experts which considered the scientific content of MAB Project I. The report focussed on the extent and nature of man's impacts on, and interation with tropical and sub-tropical forests. It is envisaged that research in this issue will provide the means for forecasting the short-term and long-term effects of man on his natural environment in the humid tropics.

1.2 General Considerations

Forests constitute a major landscape feature of the earth's surface. Their importance dates back to the story of creation as recorded in the Biblical book of Genesis, Chapter I, Verse 11: "And God said 'Let the earth put forth vegetation - plants yielding seed, and fruit trees bearing fruit in which in their seed, each according to its kind upon the earth'". Since then, forests have become a fundamental natural resource which has contributed in no small measure, not only to protecting the environment, but also to man's economic progress and comfort. Forests have formed a permanent source of land cultivation, yielding produce of firewood, charcoal and fuel, building material, fodder for animals, bushmeat, palm-wine, fruits and medicinal herbs.

1.3 The Tropical Forest: Definition and Delimitation

The biblical theory of the evolution of forests may not be questioned here, but ecologists and botanists are agreed on the evidence that regional climates interact with regional biota and substrate to produce large recognizable ecological units called biomes. Biomes are major terrestrial ecosystems occurring on a major region or sub-continental level, and they have developed on earth from a great number of possible combinations of climate, parent rock material, and available flora and fauna (Billings, 1972; Kormondy, 1976). (Biomes are often defined synonymously with provinces, regions, biochores and formations).

One of the most important of these biomes is the forest ecosystem. It has been estimated that forest cover about one-third of the total land area of the earth. Of this, about a half lies within the Tropic of Cancer and the Tropic of Capricorn (fig.1), and constitutes the Tropical Forest Ecosystem.

Attempts at definition and delimitation of the Tropical Forest have been hampered by a number of factors, among which are the size (areal distribution) of the forests, their accessibility, and overall complexity (Burth and Davy, 1938; Ellenberg, 1956, Mueller-Dombois, 1967). Exploratory definitions have also been suggested by Lebrun (1947), Schnell (1952), Richards (1952), Germain and Evrard (1956) and Schmitz (1963). The working definition adopted by the UNESCO MAB panel of experts is based on the Yangambi classification of the African vegetation (CCTA/CSA, 1956) which uses the physiognomic characteristics of the vegetation structure, combined with the broad features of relief and soil to define the Tropical Forest Ecosystem as those forests which are "evergreen or partly evergreen. Although some trees may be deciduous at one time or another, the forest is never completely leafless. In mature examples the forest is made up of several more or less distinct strata, including an upper stratum of large trees which may be 40-60m high". Though this definition is not favoured by some ecological workers, it is adopted in this paper not only because it does not differ significantly from the views of Bewbigin (1968), Odum (1971), and Longman and Jenik (1974) but also because it has relevance to the Nigerian situation and to the purpose of the present study.

Of the 2,000 million hectares of Tropical Forests in the world, about 850 million hectares make up the Tropical Rainforest - an ecosystem that represents the most luxuriant of woodland community. It is perhaps the only vegetation type in which fire is not a major ecological factor: sometimes it is referred to as the "forest that never burns" in its natural state. It represents the home par excellence of the broad-leaved evergreen tree - the plant form from which all or most other forms of flowering plants seem to have been derived.

The Tropical Rainforest ecosystem occurs where there is abundance of moisture and heat, with no drought and winter. As a result, the forests have a rich floristic and faunistic composition. Plants and animals which have no resistance to drought and cold occur here. These forests are best developed in three main regions (Fig.1):-

(i) Tropical America, particularly the Amazon basins, Brazzilian coast, central America (Atlantic coast), and the Guyanas.

(ii) Tropical Africa - in the Congo Basin and extending through Central African Empire, Gabon, Cameroun, with a narrow strip running parallel to the Guinea coast from Nigeria through Ghana to Liberia and the Ivory Coast: there are patches in the Zambesi and eastern Malagasy coast.

(iii) Tropical Asia - Pacific region - Western India, Thailand, Malaya, East Indies (Borneo), Philippines, New Guinea, North-east Australia and Pacific Islands.

These areas are characterized by a multiplicity of arboreal species, great development of stratification, numbers and varieties of climbers and epiphytes, a canopy layer of continuous evergreen carpet, and understorey stratum. Animal life is dependent on the highly productive vegetation; all trophic levels are represented in abundance, the floristic richness is greater than that of any other ecosystem type, the canopy biota being an amazing collection of an almost infinite variety of adaptations to ecological niches. As an ecosystem, the tropical rainforest is the most productive of all (Billings, op. cit.)

1.4 The Problem of Study:

Today, man is steadily encroaching on the Tropical rainforest ecosystem. With a growing world demand for forest products, interest in this ecosystem is increasing rapidly. It is seen as largely unexploited area for colonization and agricultural development, as well as a potential source of foreign capital. As a result, the forests are being drastically modified. This large scale modification or destruction of the forests has to be seen as a scientific concern because of their ecological diversity, structural complexity, richness in species, and genetic variability. This is important as the forest plays a significant role in environmental protection. As of now, little is known of the extent and nature of man's increasing impact on tropical rainforests, so that it is difficult to foretell the ecological, social, cultural and economic consequences of the changes now taking place. It is however, envisaged that on a larger scale, the tropical rainforests, because of their areal extent, their biomass and dynamics, play an important role in global ecology, and are of vital importance in maintaining environmental quality far beyong the confines of the tropics.

The purpose of this paper is to examine the Nigerian Tropical Rainforest in the context of the MAB Programme, and to use the Forestry Research Institute of Nigeria's Moist Forest Research at Gambari, Sapoba, Ohusu and Oban in assessing Nigerian's contribution to the MAP Project I.

The Nigerian Tropical Rainforest

The Nigerian Rainforest region occupies the coastal zone extending from roughly the latitude of Ibadan through Benin and Ubiaja, Owerri and Bende to Oban in the Cross River State. The region is characterized by almost all-year round rainfall, with annual mean of not less than 1220 mm and a lowest mean monthly relative humidity at 9 a.m. of not less than 70%.

It is often considered necessary to subdivide the Nigerian Rainforest into (a) Mangrove Swamp Forest made up of species of Rhizophora with stilt roots and occupying the Niger Delta. (b) Fresh water Swamp Forest of floating grass Vassia cuspidata and Pandanus, behind which occur Cyrtosperma senegalessis and Raffia palms. Here the tree species include Symphonia gabonensis, Ficus spp., Cleistopholis patens, Sarcocephalus nervosus and Mitragyna ciliata. (c) The Lowland Rainforest - the structure of which is a function of the relative maturity of the forest and the manner it has been influenced by man and animals. This paper focusses on this third category of the Nigerian Tropical Rainforest, (herein referred to as the Nigerian Rainforest ecosystem).

In a relatively mature Nigerian Rainforest ecosystem, there are three strata of trees: first, emergents of about 120 feet (3600 cm) high, making up the upper storey: most of the species are important timber producers. Second, the middle storey, about 50-120 feet (1500-3600cm) high with crowns touching each other, and third, the under storey, consisting of trees up to 50 feet (1500cm) high, with spreading crowns, short boles and often bound together with woody climbers. Beneath this is the shrub layer of young trees of walking-stick thickness.

Richards (1952) has identified various tree species in this ecosystem which belong to the sterculiaceae, e.g. Triplochiton scleroxylon, Sterculia rhinopetala, S. Oblonga, etc., to the ulmaceae and Moraceae, e.g. Triplochiton, Superba, Khaya grandifoliola, etc., to the Meliacae and Leguminaceae, e.g. Khaya ivorensis, Entandrophragma, Hylodendron gabunenses, and Piptaneniustrum africanum.

The Rainforest is the major source of Nigeria's timber resources as well as an area for food production of a growing population. What now remains of this ecosystem have been constituted as Forest Reserves. It has been inhabited and farmed from time to time, its chief enemy being the destructive method of shifting cultivation, with its attendant methods of cleaning patches of the forest, felling trees, burning and crop planting. Today, a large part of the ecosystem has turned into secondary forest.

From the viewpoint of the MAB programme, our knowledge of the effects of human activities on this ecosystem is fragmentary, and so the Forestry Research Institute of Nigeria (F.R.I.N.) maintains Moist Forest Research stations (M.F.R.S.) at :

(a) Osomari, Mamu, and Ogbakuma (Anambra Basin)

(b) Ubiaja, Sapoba, Urhorigbe, Aviele, Uzairue, Iguobazuwa (Benin Sands Area)

(c) Ohaji and Arochukwu (Ameki-Bende Sands)

(d) Udo, Ikom, Obubra and Oban (Cross River),

(e) Gambari, Ilaro, Olokemeji; Ohosu, and Shasha (Western Area.)

These experimental stations are sited in moist-deciduous forests, a great part of which has been exploited on the out-turn volume basis in which case, only the volume of timber removed is paid for. An equally extensive method of regeneration - the tropical shelterwood system which could be financed by the proceeds from the forest exploitation was considered appropriate. The stocking of the natural forest does not seem to have been much influenced by this, and today, there is the growing need to study the dynamics and alternative management practices, and human ecology of the Nigerian Rainforest Ecosystem. The remaining parts of this paper consider these aspects of the study and the preliminary results from four of the research stations.

The Dynamics and Alternative Management of the Nigerian Tropical Rainforest Ecosystem

Much of the Nigerian Tropical Rainforest ecosystem has been greatly disturbed, and it is from such an ecosystem that the effects of human impact may be meaingfully and fruitfully studied. Baseline studies embarked upon by the Moist Forest Research project have the objective of providing environmental and ecological data from a natural unmanaged forests mainly in Sapoba, Oban, and Ohusu, (fig. 2) for comparison with modified managed forest ecosystems (Olokemeji, fig.3) and managed agro-ecosystems derived from the forest (Gambari, figs. 4 and 5).

For the unmanaged, undisturbed forest ecosystems (fig.2), may be seen natural gaps caused by the death of dominant species or climatic factors, such as strong winds: the gaps contain natural succession of regeneration. Effects of selective exploitation, shifting cultivation and such activities as hunting and food gathering are evident. The evaluation of effects of human activities here would involve studies of the floristic composition and dynamic ecology of patterns within the forest, natural succession in the gaps, natural fauna of the forests, and of the physical and chemical properties of the soil, soil micro-fauna, climate and micro-climate of the forest environment.

A number of management and natural regeneration techniques have been evolved to establish adequate natural regeneration of value timber species at the time, before the exploitation of the forest: e.g., the Malayan Uniform system in which unwanted species are poisoned at the time of exploitation so that the canopy is provided with hight for the generation of commercially valuable timber trees.

In the Sapoba ecosystem, the Tropical Shelterwood system, in which undersirable canopy and understorey tree species are gradually removed by poisoning so that light reaches the forest floor, has been introduced (fig.3) Success has been achieved with such species as Khaya and Entandrophragma as well as with Terminalia ivorensis, T. superba, and Triplochiton scleroxylon. Evaluation of the effects of human activities here involves an appraisal of the management technique and determination of commercial use for unused species.

In some parts of the Sapoba forest ecosystem, at Ohosu and Oban forest seedlings and saplings raised in nurseries are being used to re-establish crops of valuable timber. The best known of these artificial regeneration methods is the "Taungya" or "shamba" systems (fig. 4). The present technique is establishment of stands of fast growing exotic timber trees at close spacing under intensive forest plantation management, e.g. Gambari Reserve. The technique has found success with Khayaspp., Terminalia spp., Tectona grandis, Gmelina arborea, Pinus spp., and Eucalyptus spp.

Commercial crops other than timber species e.g. cocoa, cashew, coffee, bananas, and rubber are being established under similar agro-silvi-cultural methods (fig.5) at Oban, Olokemeji, and Gambari. The effects of various methods of cultivation and land use on soil structure and fertility of agro-systems derived from the rainforest ecosystem are also being monitored at Gambari and Ohosu (fig.6). The expected effects and studies necessary for the evaluation of such effects are listed under the figures.

2.3 Aspects of the Human Ecology of the Nigerian Tropical Rainforest Ecosystem

Three aspect of the human ecology of the Nigerian Rainforest being considered by the F.R.I.N. are the interrelationships of human populations and the forest environment, human migrations into the forests and the effects on the autochthonous peoples, and epidemiological problems in the forest ecosystems. These issues have raised a number of questions as regards among others, the trends in the utilization of the rainforest lands, sequences of vegetation succession, forest productivity and cycles and budgets of minerals and materials entical to productivity and stability under various land usage conditions, impact of clear cutting on soil structure, nutrient retention, regenerative capacity, hydrological cycle; effects of loss of forest diversity on plant pathology, genetic variety, and animal epidemics and diseases, relations between biological productivity, yield, diversity, effects of road construction, growth in settlements, land tenure policies, epidemiological impact on man, animals and plants, effects of forest manipulations on the social, cultural and economic characteristics of the inhabitants of the forest lands, and methods of assessing and predicting these effects.

In order to attempt answering these questions, the F.R.I.N. is experimenting on the use of tropical optimization and prediction models proposed by MAB panel of experts as means of establishing optimum balance between exploitation and conservation in the humid tropics. The models have the objectives of identifying factors and critical points of control, clarifying concepts and ideas, and improving communication among people of different disciplinary backgrounds.

One such model which has appealed to scholars in this project is the compartment model based on the drainage basin approach. The approach recognises that an ecosystem is composed of structural elements (flora, fauna and abiotic matter) which can be analyzed at various levels, using data defining climatic variables, composition and structure of flora and fauna, soil variables and soil-biological variables (fig. 7). What follow are preliminary results of the investigations at the research stations in the study ecosystems.

<u>Preliminary Results of Studies on the Effects of Increasing Human Activities on the Nigerian Tropical Rainforest Ecosystem</u>

Baseline studies established by the F.R.I.N. at Gambari, Sapoba, Ohusu and Oban Research Stations include, study of the existing conditions, present uses and ecological changes taking place in these Rainforest environments, impact of land use alternatives on the fertility of the forests, effects of loss of biological diversity, effects of human settlements, epidemiological impacts and effects of the forest ecosystem manipulation on cultural and behavioural characteristics of the autochthonous peoples. A programme has also been mounted to:

(i) identify, study and estimate biomass of the vegetation, study micro-climate and water regime, and soil characteristics.

(ii) study the effect of deforestation (including clean felling) and subsequent reforestation with exotic or indigenous monocultures or polycultures.

(iii) study the effect of continuous cultivation and fire and changes in the floristic composition of the shrub layer.

3.1.1 Existing Conditions in the Ecosystem

The desire to increase local employment and the need to obtain much-needed foreign capital through exports of timber, minerals and other forest products (coupled with the increasing demand for tropical hard-woods), the necessity to expand agricultural lands for an increasing indigenous population, and the obvious desire to raise local standards of living, have acceleteted a wanton ingress into the rainforest areas. These have resulted in rapid and drastic depletion and deteroriation of the forest lands, often without regard to utilization of the renewable resource on a sustained yield basis. The present development plan which has emphasized construction of roads, industries and schools, and the Operation Feed the Nation Campaigns has also taken its tole of the forests. Much less information is available on the successional changes following partial or complete felling of the forest trees, and on the biota of the various kinds of artificial or replacement ecosystems. However, the tropical shelterwood and Taungya systems of management have proved successful.

3.1.2 Impact of Land-use Alternatives on Fertility

Throughout the Nigerian Rainforest ecosystem, information on nutrient cycling and concentrations, and of the physical characteristics of natural unmanaged areas is lacking. However, data from the research stations incidate that mature rainforests are characterized by large amounts of chemicals stored mainly in the vegetation mass and by relatively closed chemical cycles between vegetation, animals, and soil. Mineral nutrient levels are maintained by input from weathering and rainfall. Moreover, the physical and biological characteristics of the forests appear to be constant over time. When the forest is replaced by man-made ecosystem, the nutrients stored may be lost, thus changing the biotic and abiotic conditions in the system. It is not yet clear under what conditions the re-established vegetation re-establish and maintain the nutrient levels or alternatively diminish them to produce infertility.

Effect of Loss of Biological Diversity

Ecosystem diversity, measures of biological life diversity and taxonomic diversity are being observed in the study areas. It seems, however, in virgin and old secondary tropical rainforests that measures of taxonomic diversity reach their highest levels. High diversity has usually been associated with high stability and high resistance to disturbance. Reduction of taxonomic diversity occurs with intensification of forestry, destruction of forests, and expansion of areas devoted to agriculture at the expense of forest cover. This will have serious consequences on productivity and stability, on human health and on the quality of the environment.

Aspects of Human Ecology of the Rainforest Ecosystem

The human ecology of the Nigerian Tropical Rainforest is considered a priority study problem. It has been established that the forest areas are now disturbed and modified systems in which specific human actions are very important. The interference between the human components (demographic structure, settlement patterns, land use practices, social and cultural characteristics, etc) and the rest of the forest ecosystem, demands specification of the flow of energy, nutrients, water, pollutants, toxic and disease agents through and within the human population. This human biological approach requires specification of the various types of exploitation activities exercised by man in the ecosystem and the consequences of these exploitative activities. The dynamic relationships involved have been structured by Weiner (1974, fig.8). These relationships involve :

(i) pressure on and from the human component, which results to increase in numbers and increase in demand which intensify the exploitation of the resources of the ecosystem with far-reaching ecological consequences

(ii) the effects of such exploitative activities as agriculture, industry and urbanization activities the performance of which is in no small measure influenced by biotic and abiotic factors.

Evidence shows that the culture and organisation of autochthonous peoples of the rainforest ecosystem is often modified by contact with other cultures. Moreover, the development of human settlements directly and indirectly changes the nature of the balances and interrelations between structural units in these areas. The consequences of these may include those attendant with urbanization and its problems of space, sanitary conditions, sewage and waste disposal. There are also the ever-increasing need to produce more food. Such settlements may be promoted by improvement of accessibility through the construction of roads and transportation systems. Different land tenure systems and degrees of governmental control also do determine or even modify the character of human settlements and therefore, bring about changes in the ecosystem. In Sapoba and Gambari forests, for example, there is extensive immigration of new populations in search of various types of work in the rich but unexploited agricultural lands, the rubber, cocoa and kola-nut plantations, or even in the timber exploitation ventures. The influence of these migrants on the indigenous populations, on the existing ecosystem conditions, and the effects of these on them may only be imagined. They disturb the existence of the original forest dwellers, and the adaptation to forest environment presents a new set of problems to them.

The MAB programme is undertaking studies on the epidemiological problems in the tropical rainforest ecosystem. This ecosystem is perhaps the most complex of terrestrial biotic ecosystems, and are characterized by a delicate balance between a large number of plant and animal species. Present management practices drastically and abruptly change this delicate balance, sometimes with harmful results for health, agriculture and animal breeding. Management and exploitation may lead to the emergence of new pathogens, new vectors, new disease reservoirs and new insect and rodent pests.

The F.R.I.N., in collaboration with University College Hospital (UCH) Ibadan, is maintaining a research project at Ibarapa near Abeokuta which is considering:-

(i) endemic diseases typical of man, animals and plants.

(ii) diseases introduced through migration and which cause epidemic disaster on the autochthonous populations, and

(iii) the appearance of new reservoirs and vectors, potentially poisonous plants and animals, and persistence in the soil of sporulating bacteria.

Results of these research efforts are being awaited. Suffice it to say that human and social aspects cannot be separated from the patterns and uses of the ecosystem in which man lives. Human populations show specific biological behaviour in the tropical rainforest ecosystem with regard to demography, health, culture and land-use practices. As has earlier been stated, the tropical rainforest ecosystem plays a significant role in global ecology: knowledge of the ecosystem in terms of the effects of human activities, it is hoped would go far beyond the confines of the tropical world in maintaining environmental quality .

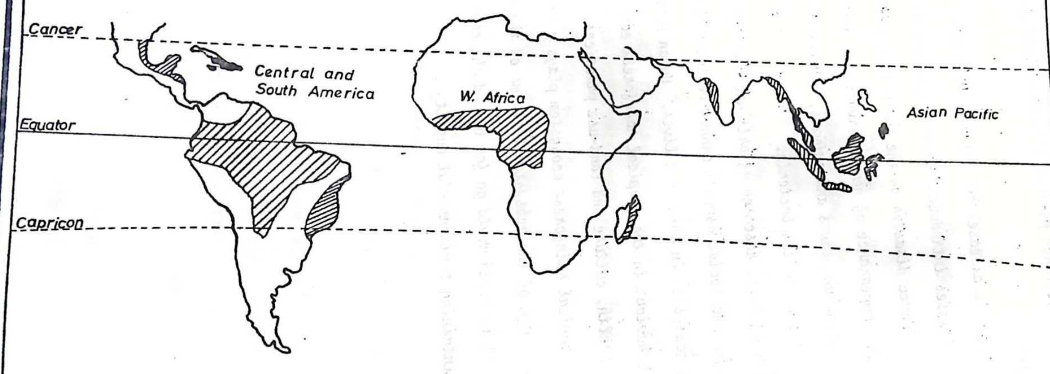


Fig. 1 DISTRIBUTION OF TROPICAL RAINFORESTS.

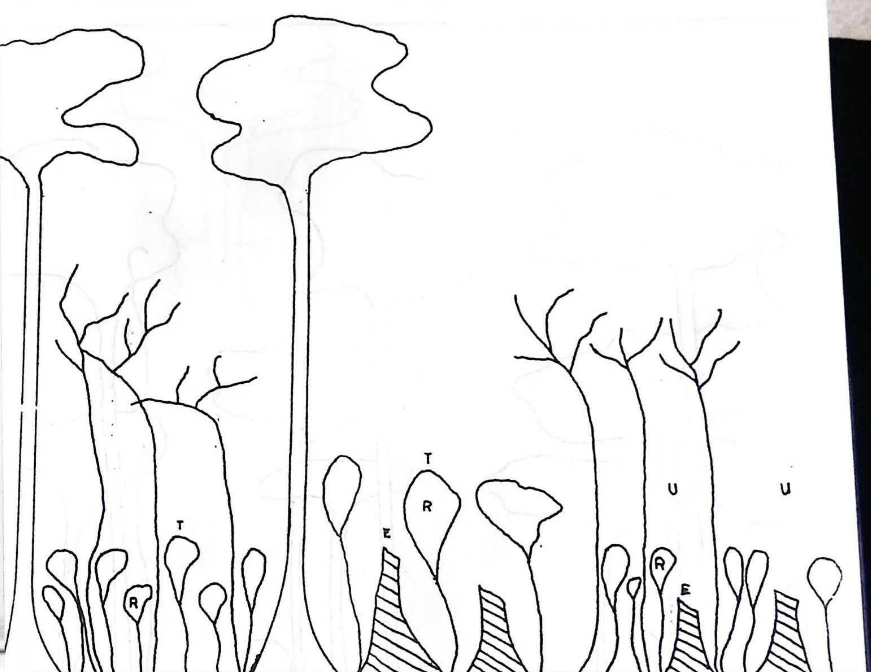


Fig 2

NATURAL TROPICAL FOREST ECOSYSTEM (MANAGED)

Natural regeneration method following exploitation.

T: Tropical shelterwood System. The removal of understroy trees and establishment of natural regeneratioo to exploitation.

E: Tropical shelterwood system: Exploitation following establishment of regenerat

U: Malayan Uniform System: The removal of unwanted trees at the tim of exploitation to assist establishment of natural regeneration.

R: Natural Regeneration: Natural regeneration assisted by managment technique.

Human influence: Canopy manipulation by management techniq

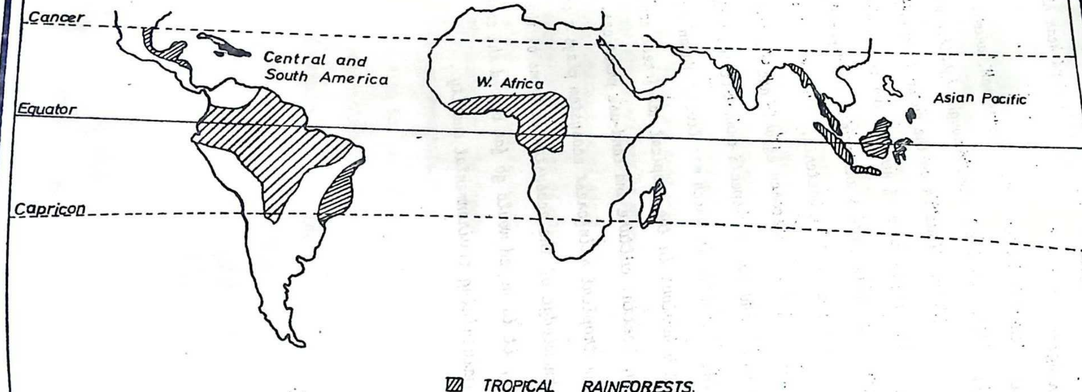
Projects.

1) Evaluation of management technique.

2) Investigations to determine commercial u for unused spices.

3) Comparison with base line studies.

3.



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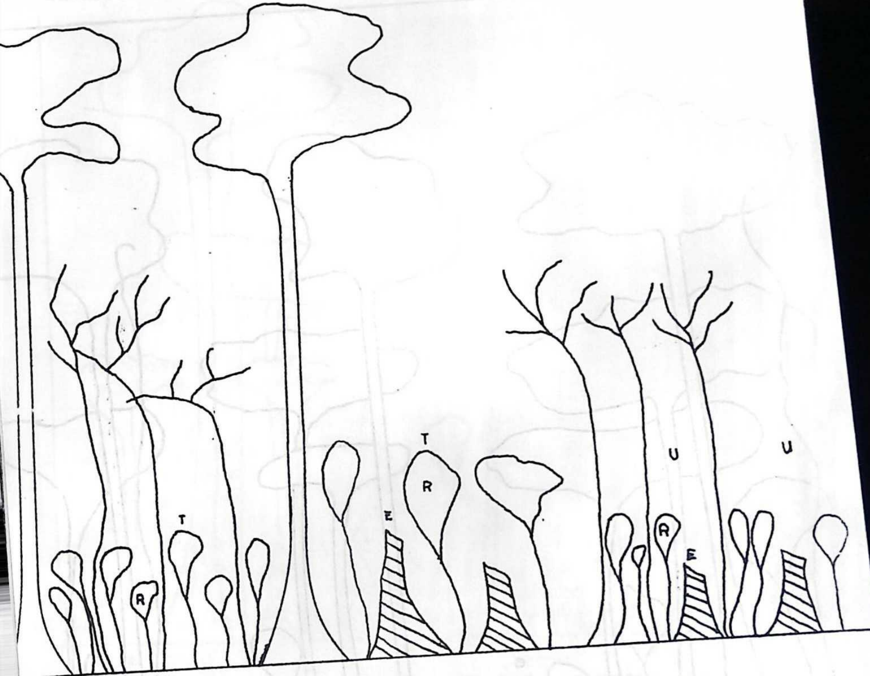

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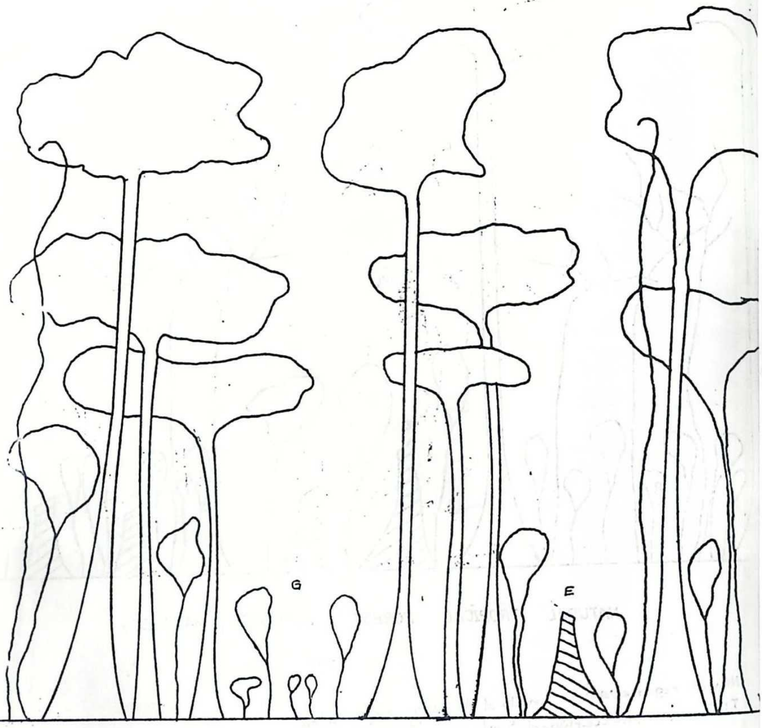


Fig. 3

NATURAL TROPICAL FOREST ECOSYSTEM (UNMANAGED)

G:	Natural gaps.	Caused by death of dominats or climatic factors eg hurricane or elephant activity, contains natural succession of regenera
E:	Exploitation	Selective exploitation followed by natural regeneration.
S/C	Shifting cultivation	Period of shifting cultivation followed by natural secondary forest fallow.
Human influence		Hunter gatherer communities and shifting cultivation
Projects		Base line studies in Biosphere 1) Floristic composition and dynamic ecology of patterns 2) Natural succession in gaps. 3) Studies of the fauna. 4) Soil investigations (Microbiology 5) Climatic studies.

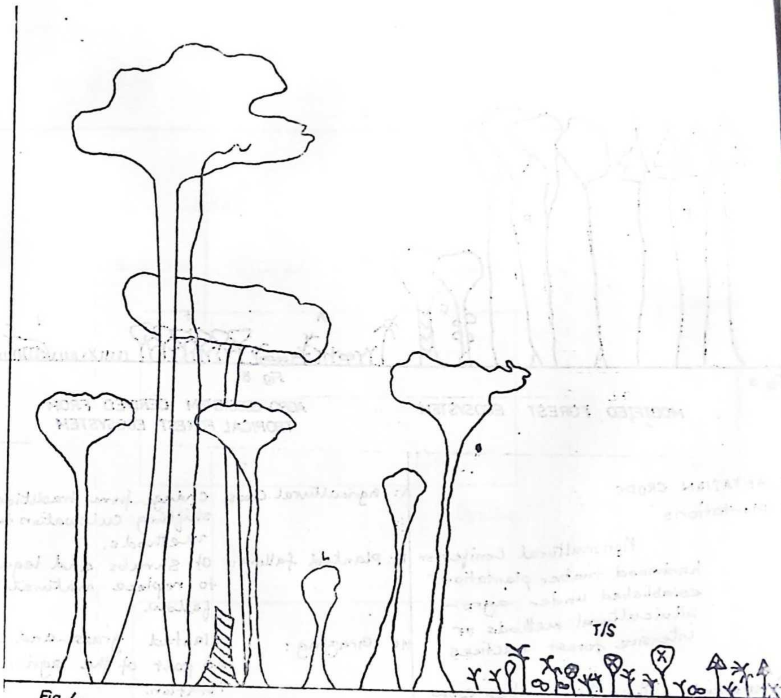


Fig 4.

MODIFIED TROPICAL FOREST ECOSYSTEM (MANAGED)

Exploitation followed by artificial regeneration including agro-silvicultural methods.

L: Line planting: Sapling planted along cut lines in exploited forest.

T/S Taungya/Shamba Systems. (Agro-silvicultural Methods) The establishment of tree crops along an agricultural crop.

X Tree: Planted in the agricultural crop.

Human influence: Line clearing, planting and weeding, forest clearing, cultivation of food crops and protect planted timber trees.

Projects:

1) Detailed evaluation of agro-silvicultural methods
2) Comparison with base line studies.

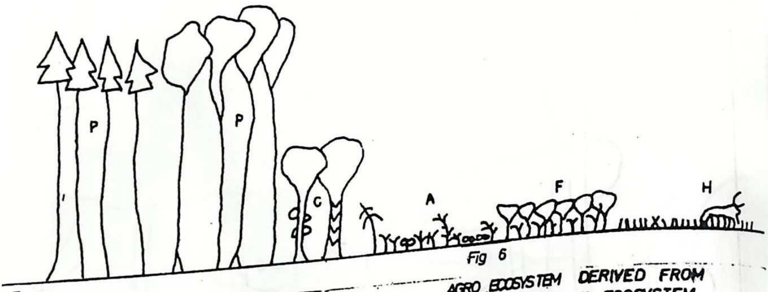


Fig 5 MODIFIED FOREST ECOSYSTEM

Fig 6 AGRO ECOSYSTEM DERIVED FROM TROPICAL FOREST ECOSYSTEM

PLANTATION CROPS

P: Plantations — Monocultural conifer or hardwood timber plantations established under agro-silvicultural methods or intensive forest practices.

C: Commercial Tree Crops: Other than timber crops eg cocoa and rubber.

Human influence: Clearing, planting, weeding tending and harvesting.

Projects:

1) Monitoring growth rates of plantation.
2) Effects of monoculture on soil structure and fertility etc.
3) Comparism with base line studies.

A: Agricultural Crops: Change from traditional shifting cultivation to ne methods.

F: Planted fallow: Of shrubs and legume to replace natural trop fallow.

H: Grazing: Planted grass and cattl as part of the agricultur rotation.

Human influence: Cultivation of agricultural crops, intensive managmen application of fertilization and harvesting etc.

Projects:

1) Effects of changing method of agricultural factors. micro-biology nutrient cycl hydrological cycle etc.
2) Comparism with base line Studies under natural forest system.

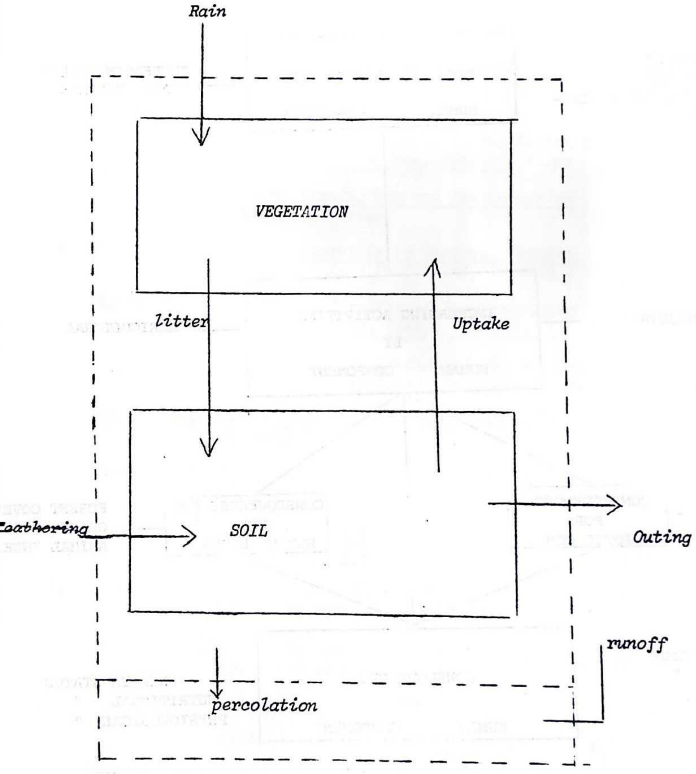
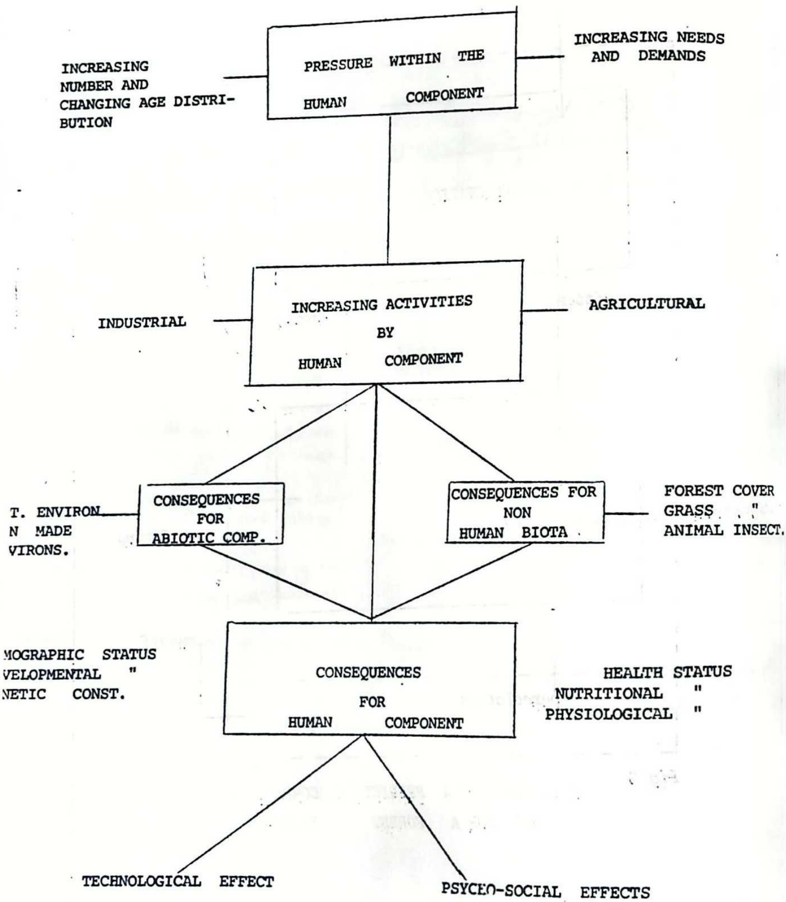


Fig 7 COMPONENTS OF A PREDICTIVE COMPARTMENT MODEL FOR A FOREST ECOSYSTEM



NAMIC RELATIONSHIP OF THE HUMAN COMMUNITY WITHIN THE TROPICAL RAINFOREST ECOSYSTEM (after Werner 1974)

Fig 8.

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HYPERSENSITIVITY AND PHYTOALEXINS

by

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INTRODUCTION

The attack of living plants by parasites or pathogens result in the infection of such plants with specific diseases depending on the type or types of pathogens.

Plants naturally react to diseases in self preservation. There are therefore many attributes of the plants or in this context hosts which reduce the chances of infection or pathogen development. These attributes are referred to as DEFENSE MECHANISMS, which differ in nature and composition depending on the point of penetration of the pathogen, the disease escape of the host, and the nutrient contents of the host tissues. The defence mechanisms could be broadly classified into:-

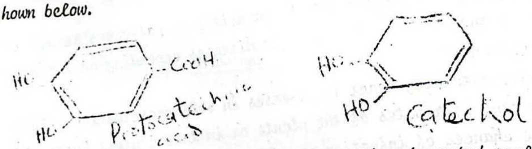
(1) Passive defence mechanisms
(2) Active defence mechanisms
(3) Nutrient Content of tissues

The passive defence mechanisms comprise:-

(1) Resistance to Penetration which is dependent on:-
 (a) Epidermal structure
 (b) Active defence mechanisms
 (c) Tissues containing Antibiotic substances.
 (d) Differentials susceptibility to the pathogen.

The epidermal structure of hosts is important because of its lipoidal materials which resist pathogenic penetration. It is known that an increase in the surface lipids of tomato fruits enhances their resistance to penetration by the hyphae of Botrutis cinerea. The epidermal lipoid material on host surfaces makes it fairly difficult for pathogens to adhere to their surfaces. The stomate structure is a factor of resistance to penetration only by certain pathogenic bacteria. Citrus canker disease is caused by Xanthomonas Citri when introduced to grapefruits and mandarin oranges. Under natural conditions the resistant mandarin varieties possess broad cuticular ridge protecting over the stomates leaving only a narrow slit through which rain-drops containing fungal spores and bacteria do not easily pass. The susceptible varieties of grapefruits have less developed lips over stoma and the cavity stands open to the atmosphere, allowing easy entry of pathogens.

An example of host resistance to pathogen by the nature of its tissues containing Antibiotic substances is in pigmented onions. Onions show resistance to Colletotrichum circinans which causes onion smudge. Fungal spores of this pathogen fail to germinate on the coloured scales of onions. But when the dried scales are removed, the onions become susceptible to the attack of the pathogen. K. Link and J. Walker found out the resistance to Colleotrichum circinans by dried scales of pimented onions is because of the presence of such active factors such as protocatechnic acid and catechol as shown below.



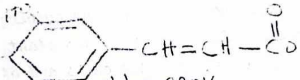
These compounds inhibit spore germination. The pigmented scales of onions only become inhibitory to the fungus only upon their death and the compounds responsible for fungitoxicity are attributable to colourless compounds released from dead scales.

In differential susceptibility to the pathogen, in stripe diseases of cereals caused by some rusts and Helminthosporium, the mycelium is only able to spread within the chlorophyll containing parenchyma tissues and not the lignified sclerenchyma surrounding the vascular tissue. With disease - escape, the longer the susceptible tissues are exposed to the pathogen, the greater the chances of infection. Plants emerge showly and irregularly and so remain exposed to the pathogen for long periods when the tissues are young and susceptible, resulting in a high incidence of disease, for example plants from small weak grains. Ergot caused by Claviceps purpuea is a good example where growth characteristic of the host obviate the chance of infecti[on]. The nutrient content of tissues have a correlation with the pathogen effect. An illustration of this is found in plumtree bark in which the amount of myo-inositol determines its degree of susceptibility to invasion by Rhodosticta quercina which produces bark canker. The less of Myo-inositol present, the more susceptible to attack the plumtree bark is.

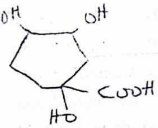
ACTIVE DEFENSE MECHANISMS

In contrast to the passive means of disease resistance, some active mechanisms in a plant are able to prevent pathogen invasion of tissues after entry into the host. Those active defense mechanisms are many and varied. In some cases, the tissues of the host are stimulated by the parasite to produ[ce] barricades of tissue that mechanically prevent the further spread of the pathogen in the host. The abscission layers produced around lesions on leaves infected by certain fungi prove this right. On the whole, the active defence mechanisms entail cytological and histological reactions of the host to produce the final products of the preceding biochemical events.

These active defense mechanisms are where the phytoalexins and Hypersensitivity come in. Others include phenolics both as preformed and post-infectional factors in disease resistance, response to injury and induced immunity. Plants may contain some phenols whose degree of resistance to infection is dependent on the amount of these phenols present in the plant. The works of S. Lee and D. Le Tournea showed that there is a correlation between the amount of chlorogenicacid in the roots of resistant varieties of potatoes and the resistance to Verticillium albo-atrum with disease.



chlorogenic acid



A. Patil also showed that the higher the level of the phenolic compound in the resistant varieties reflects a greater synthetic capacity of resistant plants to produce this antibiotic substance. Oat plants contain avenacin, a flourescent glucoside that inhibits the growth of several fungi and bacteria. These are phenols preformed as factors in resistance to pathogens. Some other plants contain other types of phenols which stimulate the production of other phenols only when a pathogen gains entry into the host which inhibit the activity of the pathogen contained inboth resistant and susceptible varieties. In apples, both the resistant and susceptible varieties contain phloretin and glucose. But in resistant varieties, phloretin is oxidised by phenoloxidases to yield highly fungitoxic compounds which check the havoc of pathogens. Plants respond to locally sustained injuries by producing antifungal substances, formation of cork layers, tyloses or gum, callus-like swellings or calosities on the wall.

HYPERSENSITIVITY

This term was first used by Stakman (1915) and it denotes increased sensitivity as in the rapid death of a host in the immediate vicinity of he site of infection. The invading parasite may find itself surrounded by a one of dead host cells and if it is a biotroph its growth may be prevented. esistance here is due to the extreme sensitivity of the plant tissue, and haracteristic small necrotic leisions develop. This resistance mechanism s of great significance with obligate parasites such as rusts and powery mildews. Hypersensitivity is also significant with some necrotrophs hich obtain their nutrients from dead tissue. It is not just a matter of tarving the pathogen, presumably, the dead tissue becomes toxic to invading athogen, perhaps related to the development of phenolic or other compounds xic to both plant and pathogen. Scheffer (1961) suggested that in normal ssue, phenols are kept in a reduced state by reducing agents such as corbic acid or dehydrogenases, whereas in hypersensitivity, they are nverted to toxic quinones due to the tissue having insufficient reducing ents. In some cases, the fungus may be confined to the hypersensitive leision in an attenuated state, neither growing nor producing spores and evantually dying.

Hypersensitivity has been studied chiefly in rusts, powdery midews, and potato blight (Phytophthora infestans), and wart (Synchytrium endobioticum) barley stripe (Pyprenophora graminea), apple scab (Venturia inaequalis), Pellicularia filamentosa), (Rhizoctonia solani) on various plants, several bacteria plant pathogens and in viruses. The rapidity and intensity of the reaction vary in different host - pathogen combinations as do the cytological changes. There is usually an immediate rection in Red clovers resistant to Brysiphe polygoni, with rapid disorganisation of the invaded cells and of occasional surrounding cells; infected cells and the invading hyphae soon die whereas this would not happen in susceptible varieties of Red clover. This work was done by Smith (1938). Resistant barley varieties attached by Erysiphe graminis show collapse of mesophyll cells near the infected epidermal cells, perhaps caused by toxin to which susceptible plants are tolerant (Whit and Baker, 1954). Essentially, similar results have been reported for other diseases in which resistance appears to be related to hypersensitivity. In many cases, it seems that the infected host cell is killed before the parasite. Klement and Goodman (1967) pointed out that hypersensitivity is associated with loss of cell turgor and suggested that it might result from cleavage of S - S bonds in the proteins of cellular membranes leading to increased hypersensitivity reaction.

HYPERSENSITIVITY HYPOTHESIS

This was put forward by Tomiyama (1963) for hypersensitivity reaction in resistant tissues.

(1) The metabolism of the infected cells temporarily increases, becomes abnormal and the cells die. This occurs rapidly in metabolically active cells and resistance is directly correlated with the rate of dying.

(2) The metabolic activity of adjacent uninfected cells may increase, and phenolic and other substances may accumulate, some of these perhaps being transported into the leisions. Phytoalexins may be formed as well.

(3) Phenolic and other compounds develop in the leisions, completing the death of the infected cells and also (but probably later) of the pathogen.

(4) Adjacent uninfected cells may start repair action by the formation of cork barricade layers and in some cases, the leisions may be sloughed off.

It is not yet know whether the toxic phenolic compounds which accumulate in the leision cause the death of the host cells and the pathogen or whether they are as a result of necrobiosis.

Time is an important factor in the effectiveness of hypersensitivity as a resistance mechanism. If the host reaction is too slow, the invading pathogen may be established and out of reach by the time the mechanism attains a fungistatic level. Similarly, if the reaction is too mild, the pathogen may be able to withstand it. The infected cells of resistant tissue may begin to collapse after only a few hours, but the process takes several days in some rust infections. Cells of resistant potato tubers die 1-2 days after infection by Phytophthora infestans whereas those of susceptible tubers remain a alive for up to three weeks. That there is a strong connection between hypersensitivity and respiration is suggested by the fact that treatment with respiratory inhibitors reduces hypersensitivity of potato tubers to Phytophthora infestans as discussed by Muller (1959) who considers that increased respiratory activity occurs. Treatments with narcotics, such as chloroform, may also reduce hypersensitivity and resistance, and Tomiyama (1963) suggests that inhibition of oxidative metabolism may be involved.

Jhooty and Yarwood (1967) have recently made an interesting observation that the normal resistance of cowpea (Vigna sinensis leaves to certain powdery mildews could be reduced by appropriate heat treatment (for example 50^{o} C for 20-70 seconds) before inoculation; such treatment induced necrotic leisions on cowpea leaves inoculated with Erysiphe polygoni from clover, There are many reports of hypersensitive collapse of infected host cells in resistant tissue, and the idea of a casual relationship between hypersensitivity and resistance has been widely accepted. Nevertheless, there are cases in which the two do not seem to be casually related, and it would be wrong to conclude that the mere occurrence of hypersensitivity is in itself proof that the latter is the mechanism of resistance. Brown, Shipton and White (1967) were unable to find any resistent relationship between the colony size of Puccinia graminis f. sp tritici on wheat leaves and the rate of increase of collapsed tissue. They concluded that hypersensitivity was neither the only nor necessarily the most important factor in resistance to this fungus, and suggested that hypersensitive necrosis of host tissue is not the cause of resistance but rather a consequence of infection in the resistant hosts used. Hypersensitivity is a complex phenomenon involving in some cases at least the formation of phenolic compounds and sometimes of phytoalexins. It is an effective resistance mechanism against some pathogens but not against others, being only one of the defensive reactions of the plant against invading pathogens. Because hypersensitivity and phytoalexins are produced concomitantly, they are always considered together.

PHYTOALEXINS

These are a special group of post infectional phenolics that are antibiotic The term phytoalexin is derived from "phyton", a greek word for a plant "alexin", a greek word for a wardingoff compound. According to (Muller 1956) phytoalexins are antibiotics fungitoxic or bacteriotoxic that are produced as a result of the interraction of two metabolic systems, the host and the parasite and that the antibiotics so produced inhibit the growth of microorganisms pathogenic to the plant. Many of these phytoalexins have been isolated and identified. They are associated with the metabolism of aromatic phytoalexins do not seem to be related specifically to the pathogen in the same way as animal antibodies. This means that stimulation by one micro-organism resulting in the production of phytoalexins will tend to increase the resistance of the plant to infection by other micro-organism.

THEORIES OF PHYTOALEXINS

(1) Muller and Associates (Muller and Borger, (1940), Muller, Klinkowsky, and Meyer, 1939, Meyer, 1940) proposed a theory to explain the difference in disease reaction they observed in the course of studies of the symptom responses of cut tuber surfaces of potato varieties to inoculation with virulent and avirulent strains of Phytophthora infestans. This theory which has since been called the phytoalexins theory stated that resistance was due to the formation of an antifungal compound in the host cell as a response to fungal infection, and that such newly formed chemical substance designated as "phytoalexin" was responsible for the inhibition of further fungal growth in such tissues. Phytoalexin was considered to be nonspecific in its toxicity towards fungi. The basic response which occurred in resistant and susceptible host varieties was considered to be qualitatively similar. The basis of differentiation between resistant and susceptible host varieties was postulated to be the speed of formation of phytoalexins. The phytoalexin theory has been restated by Muller (1956, 1959 and 1961) in the light of subsequent experiments, but no major changes of theoretical importance have been made.

(2) At about the same time as Muller and associates were working in Germany, Offord (1940) in California also advanced a theory to explain disease resistance in plants. Offord postulated that the toxic action of tannin to the fungus in plant cells is initiated and conditioned by enzymes or hormones secreted by the infecting fungus. The ultimate toxicity of the tannin was considered to depend partially on the type of phenolics and other potentially toxic constituents formed by the reaction of host and parasite, and partially on the quantity and manner of distribution of the "tannin mass."

There two theories are complementary and both emphasize the dynamic nature of the interraction resulting from host parasite associations. Offords theory if interpreted broadly, suggests a possible biochemical mechanism which may be involved in the formation or release of phytoalexins.

TYPES OF PHYTOALEXINS

Compound	Source
(1) Phaseelin	From French bean with Monilinia fructicola
(2) Pisatin	Garden pea infected with Monilinia fructicola
(3) Orchinol	Orchid infected with Rhizoctonia repens
(4) Isocoumarin	From Carrots
(5) Rishitin	From potato from infection by Phytophthora infestans
(6) Hydroxyphaseollin	From soybean Hypocotyl by Phytophthora sojae.
(7) Ipomeamarone	From Sweet potato by Cercospora fimbriata
(8) Gossypol	From Cotton by the attack of Verticillium albo-atrum or Gossypium hirsutum or Gossypium barbatense
(9) 4'O-methyl Coumesterol, Sativol, Medicagol, Medicarpin.	From Alfalfaleaves by the attack of Asshochyta imperfecta, Uromyces striatus, Collectrichum trifolii
(10) Isoflavones formonouetin, Biochanin, Medicarpan.	From Red clover leaves by the attack of Sclerotinia trifolirum

In general, phytoalexin can be summarized as a group of compounds which are:-

(1) Fungistatic and bacteriostatic, and are active at very low concentrations.

(2) Produced by the host plant in response to the metabolic by-products of micro-organisms, or in response to infection or a few other stimuli.

3) Absent from healthy cells or only occur in most minute quantities.

4) Usually remain close to their site of production.

5) Produced in quantities proportional to the size of the inoculum.

6) Produced in larger quantities in response to weak pathogens and non-pathogens than to virulent pathogens.

) Produced relatively quickly by the cells, usually within twelve to fourteen hours, reaching a peak around twenty-four hours after inoculation.

) Host specific, rather than pathgen specific.

NCLUSION

A plant may be able to defend itself from attack by a parasite either passive or active mechanisms. Disease resistance is more common in nature an susceptibility. Passive mechanisms of defense include such things as nato or lenticel structure, the present of antibiotic substances, heavy gnification of cell walls, and time of flowering. K. Tomiyama summarizes the ndings of many investigators in his list of several steps involved in the tive defense of a plant to a pathogen. The summary is as follows:-

The parasite temporarily accelerates the metabolism of the host cell.

(1) This may lead to an abnormal type of metabolism, resulting in cell death.

(2) When infected cells die, the metabolic activity of the adjacent cells may be accelerated, resulting in the accumulation of toxic phenolic compounds or other substances. These substances may play an important role in preventing the growth of the pathogen.

(3) In the hypersensitive reactions leading to cell death, phenolic substances, phytoalexins or other compounds may be formed. Some phenolic glycosides may be split to aglycons (without sugars) which are antibiotic. Other phenolics may be oxidised such as chlorogenic acid of Ferulic acid. Browning of tissues may occur after cell death as a result of the action of phenolic compounds.

(4) When the growth of the parasite is strongly inhibited, the repairing action of the neighbouring tissues, metabolism of which has already been affected, may wall off or form a barricade against the pathogen. Cell division, lignification, and cork layers will subsequently follow.

(5) If the host tissue succeeds in localizing the infection by rapidly forming barricade tissue and also succeeds in suppressing excessive cell division of itself, then the infected site may be sloughed off.

(6) The toxins or degradative enzymes produced by the parasite may disturb the defense reaction. Conversely, host enzymes may detoxify the toxins of the pathogen.

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THE CHROMOSOME THEORY OF SEX-LINKAGE

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On the basis of Wilson's theory of sex-determination Morgan (1911) it has been postulated that gene for white eyes in Drosophila melanogaster is carried by X-chromosome. This hypothesis to explain the sex-linkage represented an important advance over his earlier theory (based on that of Bateson and Punnett for Abraxas), since it was no longer necessary to assume that all male Drosophilas were herozygous for white eye-colour. This is because with only one X-chromosome in the male, heterozygosity is impossible for sex-linked characters. Moreover the criss-cross inheritance of the X-chromosomes was paralleled by that of white eye-colour.

The sex-linkage of the pale form of Abraxas grossulariata was similarly explained when it was established that in Lepidoptera it is the female which has either an X-and a Y-chromosome, or an unpaired X-chromosome, whilte the male has 2 X-chromosomes i.e. the converse of the situation in Drosophila.

P	Red-eyed female	X	White eyed male
F1	Red eyed females	X	Red eyed males
F2	2459 Red-eyed females	1011 Red eyed	782 White eyed males

Fig. 1: Morgan's data for the inheritance of white eye-colour in in the normally red-eyed fly D. melanogaster.

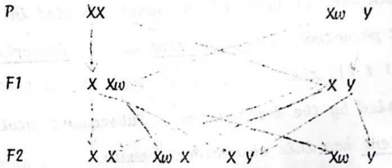

Fig. 2.

Proposed Morgan's hypothesis (1911)

X X - Chromosome with dominant normal alleleomorph of white eye gene, and hence causing red eyes.

Xw X - Chromosome with recessine gene for white y eyes.

y Y - Chromosome (plays no part in inheritance).

Note: 2 x - chromosomes give a female, 1 X - chromosome a male. The shortage of males in F2 especially those with white eyes compared with expectation can possibly be accounted for by lower viabilities.

Red - Green colour blindness in man was found to show criss-cross inheritance similar to white eye colour in Drosophila. That is to say, colour blindness is usually manifested only in males, whose daughters act as carriers of it to half their sons. The female, XX, Male XY sex-determining mechanism in man was confirmed subsequently. By contrast, the dominant character barred feather - colouring of the Barred Plymouth Rock and its recessive allele the black feather - colouring of the Black Langshan variety of Gallus domesticus were found to show sex linkage of the Abraxas type and the cytology confirmed that birds, like Lepidoptera have the female XY and male XX sex-determining mechanism. Baur (1912) obtained the first example of sex-linkage in plants. He discovered a form of Silene alba (white compion) with narrow grass - like leaves, It was found to be a staminate plant. Pollen from it was used to fertilise a female plant with normal broad leaves. All the progeny were normal and when intercrossed they gave 167 plants with broad leaves and 60 with narrow leaves in agreement with Mendelian expectation of 3:1 ratio. When 52 of the narrow leaves plants were grown to maturity all were found to be male while 23 of the broad-leaved ones comprised 15 females and 8 males in good agreement with the 2:1 ratio of the sexes expected in F2 individuals with the dominant phenotype, if <u>Silene alba</u> is like <u>Drosophila</u> in its sex-linkage (Fig.1 & 2), that is female XX, male XY, with the gene for narrow leaves carried by the X-chromosome. Subsequent cytological studies confirmed that <u>Silene</u> has this chromosome formula.

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SECRET OF FLOWERING

by

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A flower is a thing of joy and beauty for ever. If we could dictate to a plant to produce flower at our will, we will be the masters of nature. But it is still a mystery as to how a flower is formed, even though many workers have put forth various theories. The problem of the physiology of flowering has baffled the Plant Physiologist for a long time.

Flower formation signifies a transition from the vegetative to the reproductive phase of development. The vegetative apex is induced to develop sepals, petals, stamens and carpels instead of leaves. Transformation of shoot apex from the vegetative to the reproductive stage of development is probably the most profound ontogenic change in plants. A number of workers have studied the effect of factors like nutrition, day-length, light intensity, temperature, growth period and others on the differentiation and growth of vegetative and reproductive parts from the shoot apex (Chinoy and Nanda, 1946; Ryle 1961) Steward (1961) considers a study of the influence of flower inducing factors like light, temperature, hormones on the shoot apex as very important because it is the seat of all subsequent growth and differentiation in the plant. Wardlaw (1961) suggested that the development of a succession of distinctive floral organs is related to the changing matabolism of the shoot apex. During reproductive differentiation the shoot apex shows marked Morpho-physiological changes, including a change in the growth and development pattern, matabolic drift, enzymic patterns and change in the growth regulators and so on. Photoperiodism and Vernalisation treatments profoundly influence growth and developmental pattern.

The effect of cold on the induction of flowering is called vernalisation, the temperatures which are effective lie between zero and 15^{0}. Generally the aplical meristem is the receptor site for low temperature treatment. Lang (1956) has induced flowering in different species that require vernalisation such as Carrot (Daucus Caurota), by treatment with G A (Gibberellic Acid) without employing lower temperature. There are reports that other growth regulators like AA (Ascorbic Acid or vitamin C) are produced by vernalisation treatment which ultimately helps in flowering.

In 1920 Garner and Allard in U.S.A. showed that a variety of Tobacco (Nicotiana tobacum) called 'Maryland Mammoth' could flower only if brought under short day and long night condition. This is known as photoperiodism. Plants are classified as long day plants (LDP) and short day plants (SDP) depending on the critical night (short night and long night respectively) periods required for inducing flowering. The leaf is considered the organ that receives the stimulus for producing flower forming substance - once called Florigen (a hypothetical name) or a floral hormone.

The interruption of the dark period of short day plants can prevent the induction of flowering. These light breaks involve ordinary white light, the active component of it is red light, with absorption spectrum at 660m/h. If exposure to red light is followed by far-red light of wave length 730m/h, the inhibitory effect of flowering in a short day plant due to red light is overcome. This is known as the red far-red reversibility or phytochrome mechanism. Phytochrome is a chromo protein existing in plants in two stages as red light absorbing form called Pr or P660 and far-red light absorbing form called Pfr or P730. Borthwick and Hendriks (1961) in U.S.A. postulated that in Short Day plants red light or day light produces P730 the active phytochrome which inhibits the induction of flowering. At night the P730 is reversed to P660 and consequently the content of inhibitory P730 falls and the synthesis of flowering hormone begins. This floral stimulus migrates from the leaf to the apex where the gene for differentiation is activated. But what is this special flower forming hormone? Does it interact with the genetic material DNA? These are certain problems still confronting us.

Michniewickz (1961) a Polish worker has highlighted the importance of ascorbic acid (Vitamin C) in growth and development of plants. Professor J. J. Chinoy (1962), an Indian worker has put forward the Ascorbic acid-Nucleic acid - Protein metabolism concept of flowering. He has also studied the effect of vernalisation on ascorbic acid (AA) production. A parallelism between AA production and photoperiodic induction of flowering is also studied by a number of other workers too.

There are evidences which support the fact that AA is continuously being formed during germination as well as photosynthesis. The role of AA as an electron donor in photophosphorylation and oxidative phosphorylation is also studied (Mapson 1958; Aronon 1961). Vernalisation and photoperiodism help in raising the level of AA at an earlier date in the shoot apex compared to the untreated normal plants. There is overwhelming evidence for the fact that the concentration of AA increases apparently towards the onset of flowering (Chinoy et al; 1969, Abraham 1970). Considerable evidence has accumulated by now to highlight the importance of free radicals in the process of energy transfers (Beevers 1961). The oxidative reduction reactions involving transfer of electrons proceeds in two steps (Michaelis 1946). The intermediate step in this two-step electron transfer is a free radical. The free radical of AA is the mono-dehydro-ascorbic acid (MDHA). A higher free radical contant augments the energy pool (ATP pool) of the system and consequently higher metabolism, leading to differentiation. It is observed that DNA complexes with ascorbic acid and consequently the exchange of orbitals by their mobile electrons help in the activation of DNA and followed by RNA synthesis (chinoy et al; 1969). This results in the accelerated production of structural proteins and enzyme protein of the cells during the period of reproductive differentiation; and the rate of cell division and formation of growth centres are increased at the apex. In fact the switch from the ordinary mitosis to meiosis at the shoot apex is made possible by the change in nuclear constitution due to rapid metabolisms and a flower emerges instead of leaves.

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ECOLOGICAL EFFECTS OF FIRE ON SAVANNA GRASSLAND IN NIGERIA

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In recent years our environment, which was once taken for granted, has become a subject of great concern to society. Various natural forces - flood, drought, fire, etc. have shaped the biotic community over time and will continue to do so. Fire has been one of the most drastic of these natural forces in Nigeria. On a global basis, fire and man - separately and together have had a tremendous impact in shaping or altering world vegetation. Fire, therefore, has become a subject of great interest, not only among biologists and foresters, but also among conservationists.

Over the years the importance of fire to mankind has been a subject of turbulent debate. early man appreciated fire and used it in many ways for his well-being - for hunting, grazing for domestic stock, clearing of forest for agriculture, producing ash to fertilise fields, favouring certain plants over others, eliminating undesirable plant materials. Recently, the attitude towards fire changed drastically. Within a few years fire was widely considered an insidious enemy rather than a useful friend. This change of attitude was catalysed by reckless burning and by extensive publicity which dramatised only the harmful effects of fire. However, the pendulum has begun to swing again, and it has become fashionable to re-examine the beneficial effects of fire. We now recognise that fire affects all the inter-dependent components of the ecosystem.

In Nigeria, bush burning is commonly found in the Northern States in which savanna grassland predominates. The phenomenon of bush fire occurs mostly during the dry season - that is between the period of November to February. Burning of savanna grassland has been caused by early and modern man, lightning, spontaneous construction, etc. A widespread cause of bush burning was man. In many tropical grasslands man may have been the only important source of fire (Blydenstein, 1967; Budowski, 1966; Fosberg, 1960).

With this easy-to-use tool, man was able to create openings in the forest, convert forest to savanna, and change forest and bush to open grassland. Fire become man's first great force with which he asserted widespread influence over a considerable portion of the face of the earth.

The physical nature of grassland fires is simple in comparison to fires in more stratified vegetation types. Rapidly moving head fires consume most of the vegetation and often develop broad fronts because of the extensive and unbroken tarrain and the continuous nature of the fuels many grasslands. Fires spotting ahead of fronts are more characteristic of savannas where volatile woody plant elements contribute long-lasting ambers that are readily transported by winds. (Wright, 1972). Grassland fire behaviour is not only affected by the prevailing winds at the time of burning (Byram, 1948) but is also influenced by the direction and angle of slope, local winds, drafts, and conventional movements created as fires build near each other, and merge. These factors result in the temporary intensification of fire the development of firewhirls or whirlwinds, and sometimes in the production of fire storms (Scroeder and Buck, 1970). In addition, bush fires produce a narrow belt of flames and pass rapidly because of the low growth, open terrain, level to gently rolling topography, and the general presences of winds. The highest temperatures are usually produced well above the ground at the apex of the flames and above, and are dissipated by winds. Woody fuels and large accumulations of grassland litter take longer to consume and therefore produce higher temperatures (Conrad and Poulton, 1966; Have, 1961, Hopkins et al, 1948; Stinson and Wright, 1969; Wright, 1971). Heat conduction tends to increase with the soil moisture content. The burned surfaces warm readily and generate whirlwinds that lift ash into the air. The blackened soil surface is known to absorb solar heat, thereby causing higher temperatures than are produced on comparable unburned soils (Daubenmire, 1968). Some postburn soil surfaces may actually reach higher temperature from direct insolation on the exposed and darkened surfaces than they did during the fire. As the new plant cover begins to develop, the blackened surfaces deteriorate. These changes might create favourable growing conditions by first promoting warm soils that stimulate speedy seed germination, sprouting, and growth particularly in cold seasons (Aikinan 1955;

Curtis, 1959; Ehrenreich and Aikman 1963; Hadley and Kieckhefer, 1963; Kelting,-1957). Once growth has been initiated and the frowing season progresses, the breakdown of the dark ash layer reduces temperatures that could cause evaporation transpiration stress in plants and soils.

Burning has been found to increase the production of most grassland vegetation but occasionally ineffective and sometimes deleterious to individual species. Reactions to fire vary with the grassland type, fuels, soils, moisture conditions, fire frequencies, and burning times. Yields have been found to be reduced by burning marginal grasslands too frequently, at wrong season, after severe abuse, during periods of critical soil moisture (Jackson, 1965); or when exceptionally hot fires damage plants (Hopkins et al 1948, Launchbaugh, 1964). The higher yields of the above-ground portions of plants, which can be several times greater than from comparable unburned areas and which are related to corresponding increases in root systems (Kucera, 1970), are associated with a number of factors. The removal by force of the plant tops crippers latent primordial regions to initiate new growth. Growth is produced, sometimes very rapidly (Hopkins, 1963; Lewis, 1964), often regardless of the soil moisture content and the occurrence of precipitation. Increased numbers of grass and forb flowers and seeds are stimulated by burning. The blanket of dead and decaying vegetation contains nutrients that are largely unavailable for growth until released slowly and incompletely by decay, or rapidly and more completely by fire. Soils in burned grasslands usually have slightly higher PH values due to the release of alkaline earth metals (Baldanzi, 1961, Cook, 1939; Daubenmire, 1968; Ehrenreich and Aikman, 1963, Garren, 1943, Moore, 1961). In neutral or alkaline soils, these PH increases appear to have little effect, except that they may alter microbial activities.

There are generally no direct losses of soil nutrients except for the volatilization of nitrogen and sulfur. The nitrogen losses are often recovered through precipitation and the increased actions of nitrogen fixing plants, particulary legumes soil algae, bacteria and certain fungi. Mineral salts of Ca, P, K and Mg often increase with burning. Plants recovering from fire often reflect improved soil conditions by their healthy green colours, larger sizes, and higher water content (Aldous 1934, Cook, 1939; Halls, 1952, Mes, 1958; Vogl, 1965). Postburn plants are preferred by herbivores (Vogl and Beck, 1970), who seek out burned sites and unerring select the more palatable, and apparently more nutritious forage (Smith et al; 1960; Vogl, 1973). Big game in Nigeria prefer the emerging growth of postburn sites, not only because it is more palatable but because the regrowth offers improved visibility and a better chance of detection and escape from predators than the tall grasses of unburned sites. Also, there are reduced numbers of ciks, mites and flies in the open burned sites..

The presences of recurring disturbances such as fire favours grasslands, savannas in regions with climates capable of supporting forest. Repeated fires promote grasses at the expense of woody species, although a number of woody plants are extremely fire tolerant and even fire-dependent. Woody plants have difficulty established grasslands, particularly if the grassland is healthy and subject to recurring fires (Lemon, 1970: Pearson 1936; Wilde, 1958). The fire maintains vigorous herbaceous growth which successfully competes with the woody species for space, moisture and light. Grassland burning may reduce the number of woody species present, but this is usually offset by a corresponding increase in herbs. Annual grassland species are encouraged by burning, provided the fires occur at the appropriate times. Seed production, germination, and seedling establishment of annuals as well as perennial species are promoted by fire. Many perennial grasses and forbs are capable of vegetative reproduction.

This trait aids the colonization of new or often areas, as do pollination and seed dissemination by wind which are also typical of grassland species (Vogl, 1969) vegetative reproduction gives competitive advantage and helps species to survive catastrophies, including fire.

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IMPORTANCE OF THE STUDY OF PLANT PATHOLOGY

by

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Throughtout ages man and plants have been intimately associated, and, Stakman and Harrar (1957) aptly emphasised this importance of plants by their assertion that "Man occupies this planet as a guest of the plant kingdom." Indeed, the three great necessities of life - food, clothing, and shelter - and a host of other products are supplied in great part by plants. An adequate food supply is, and has been man's most outstanding need. In the last analysis all his food comes from plants.

Clothing and shelter, the other prime necessities of life are derived in great part from plant fibres and from wood. Wood is used to cure diseases and relieve suffering are to a great extent plant products. Some industries are dependent on plants for many of their raw materials. Cork, tanning materials and dye-stuffs, the oils, resins and gums used in making paints, varnishes and soaps, and perfumes; and rubber - one of the most outstanding materials of modern civilization - are but a few of the valuable products obtained from plants.

Thus, according to Hill (1952) the production and maintenance of an adequate supply of plants and plant products have a profund influence on the economic and social life of the nations of the World.

The importance of "plant public health" is becoming increasingly realized in recent times especially as it has become obvious that every aspect of human existence depends on ample and regular supplies of plants and plant products.

Unfortunately, however, a surprising diversity of plant diseases now causes immeasurable damage to crops. Disease in plants is an injurious physiological process caused by continued irritation of a primary causal factor, exhibited through abnormal cellular activity and expressed in characteristic pathological conditions called symptoms. The plants which suffer from diseases range from those which have been cultivated for thousands of years and which, during that time, have evolved into a wide range of varieties differing markedly from their wield ancestores, to those plants whose economic possibilities have been explored only recently and whose potentialities as crop plants have hardly begun to be exploited. They range from the major cash crops which usually require elaborate and expensive processing, to the simple plants grown in every peasant's garden. Thus, with increasing demands of a growing world population focussing more and more attention on crops as a vital source of food and raw materials the present global war on plant diseases seems most appropriate. The plants that have received the attention of plant pathologists and protectionists include cotton, sugar cane, cocoa, coffee, rice, rubber, oil palm, coconut palm, tomato, jute, cowpea, pepper, maize, millet, tobacco, yam, cassave, Guinea corn, kola nut tree, sugar beet, carrots, potatoes, cocoyams and many other plants grown for economic purposes here in Nigeria and elsewhere in the world.

Plant diseases may be caused by bacteria, fungi, viruses and nematodes. There are also many non-parasitic diseases of plants and a lot of work is now being done to elucidate them. Quite recently mycoplasmas and mycoplasma-like organisms have been implicated as agents of plants diseases.

Walker (1957) has remarked that the earliest known records of plant diseases may be found in the Old Testament (Gen.41:23; 1 kings 8:37; Amos 4: 9. II Cron. 6: 28; Deut. 28: 22; Hag. 2:16--17). In these verses references have been made in the history of the ancient Hebrews to blights and mildews of cereals and vine crops upon which the people depended heavily. Theophrastus (370-286BC) also noted in ancient Greece, the occurrence of crop maladies, but could only speculate as to the true nature of their causes and cure. Even in the Middle Ages many of the great scholars expressed considerable anxiety about the appearance of plant diseases, but were quite confused as to the nature of their causal agents. The discovery of viruses and virus diseases was shrouded in speculations, which, were at worst, fallacious, and at best, dubious.

It was only in 1892 that the Russian scientist IVANOVSKY showed that common disease of tobacco plants called "Tobacco Mosaic" could be transmitted to healthy plants by the sap from diseased plants even after the sap been passed through filters small enough to remove the smallest known bacteria. Since no living organism grew out of this sap when cultured on a medium, the Dutch bacteriologist, BEIJERINCK, referred to the infectious material involved in the trasmission of this disease as a "Contagium vivum fluidum" (i.e. infectious living fluid). It was much later that Scientists realised that this sap contained some infectious living particles which were then given the Latin name "Viruc," meaning "Poison".

The first devastating blow ever dealt by a single pathogen was recorded in 1845 in Ireland when the fungus <u>Phytophthora infestans</u> ravaged large acres of potato plants and precipitated the historic great famine of Ireland. This disease still continues to be a major disease of potato in the cool, humid regions of the temperate zones, even though it is often held in abeyance through the armamentorium of fungicides and chemicals.

All through the ages to the present day, great attention has been focussed on plant diseases, their causes, transmission, symptoms, effects on the yield of crops and the methods of their control. Thus the newly developed field of Science - PLANT PATHOLOGY - is primarily concerned with the health and productivity of growing plants.

Plant diseases are inumerable and vary in severity, causal agencies, and symptomology. A great many of them have been studied and documented; many others have been observed and reported but, to date, no serious studies, as such, have been conducted on them. As a result literature is not available for what should be a comprehensive World Survey of plant diseases. This poses a challenge which, the young pathologist should take up seriously with a view to contributing to this growing and enviable branch of science.

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VASCULAR WILTS

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Plants in general are subject to attack by a large variety of plant pathogens. Unless the mode of action of these pathogens is understood and methods are devised for their control, the costs to society in health, comfort, and economic well-being are enormous. A sound understanding of the principles of phytopathology and their application to the problems of plant disease control is necessary for maintaining the level of productivity of plants essential to the welfare of mankind. (10)

Whetrel (13) proposed a precise definition of the concept of disease, that serves as a logical basis for study of plant pathology: "Disease in a plant consists of a series of harmful physiological processes caused by continuous irritation of the plant by a primary agent." It is exhibited through morbific cellular activity and is expressed by morphological and histological conditions called symptoms.

In bacterial vascular wilt diseases, invasion and multiplication are within the xylem vessels and also in the adjacent parenchyma. Initial entry of the root or stem is through wounds or by insects. The affected plant wilts, and may die. On cutting across the stem the vessels are often seen to be discoloured and full of bacteria which exude as a viscous slime. The preuse cause of wilting is not clear and it has variously been attributed to toxins which damage the leaves or increase their permeability, slowing up of the transpiration stream due to the physical presence of large quantities of bacteria and bacterial slime in the vessels, gelatinous pectic substances which enter the vessels from adjacent disorganised parenchymatons cells, and other causes (11).

It seems likely that bacteria can be distributed in the transpiration stream to various parts of the plant including the seeds, and seed infection might orginate in this way. Some bacterial pathogens which normally attack parenchymatous tissues can probably invade xylem vessels as described by Wickens (15) in bacterial blight of cotton caused by Xanthomonas malvacearum. Bacterial vascular diseases include maize wilt (Erwinia tracheiphila) and watermark disease of willow (Erwinia Salicis)

Wilting has been attributed to several causes.. Firstly, toxic metabolites produced by the pathogen are carried upward in the transpiration stream. Toxins in vascular wilt diseases have been extensively investigated in tomato wilt caused by Fusarium oxysporum f.sp. lycopersici in which Gottlieb (5,6) showed that toxins might be involved. Gaumann (7) et al. have isolated three toxins from culture filtrates of Fusarium oxysporum f.sp lycopersici - lycomarasmin, fusaric and vasinfuscarin. Secondly, xylem vessels are blocked by the pathogen itself or, more probably by viscous substances (perhaps pectinaceous) resulting from degradation of the cell walls of the vascular tissue by pectic enzymes- and possibly by cellulases and hemicellulases - produced by the pathogen. The brownish discolouration of the vascular tissue, a characteristic of many vascular wilts, has been attributed to changes in phenol metabolism. Thirdly, the transpiration stream is reduced due to the formation of tyloses within the xylem vessels. Beckman et al (1) suggest that tylosis and gel formation are basically a defensive reaction of the infected plant and that in susceptible plants tylosis is inhibited or delayed. This inhibition is perhaps due to pathogen metabolites which, when present in sufficient quantities, reduce the plants capacity to produce the growth regulating substances which bring about tylosis. Rapid tylosis thus confers resistance, slow tylosis susceptibility. This interpretation of tylosis as a resistance mechanism is questioned by Dixon and Pegg (3) on the grounds that tyloses in tomato plants attacked by Verticillium albo-atrum always appeared after colonization of root, stem and petiolar xylem by the fungus.

Walker (12) showed that there are more than a score of diseases incited by forms of Fusarium oxysporum schlecht in which the pathogen, invading mostly through the fibrous root system, is present chiefly in the large xylem elements. It is generally agreed that in some instances the production of cellulolytic and pectolytic enzymes by the pathogen can result in blockage of the hosts vascular system by partially hydrolysing the cellulose and pectin of the host cell walls with the resulting gel blocking. The vascular system (14).

In a study of wilt (incited by Fusarium oxysporum f.sp. lycopersic (sacc.) Snyel and Hans. in tomato seedlings grown in quartz sand culture(2). Foster and Walker (4) showed that development of the disease was enhanced when a low concentration of potassium or a high concentration of nitrogen was used in the mineral nutrient supplied the host. A high concentration of potassium or nitrogen had an opposite effect. Recent investigations concerning the mechanism of wilting in tomato plants infected with Fusarium oxysporum f.sp lycopersici have pointed to vascular plugging as a major factor in impeding the translocation of water and mineral salts in the host (9).

The fight against plant diseases is continous. The ultimate aim of plant pathology is to banish destructive plant diseases. But the aim is far from attainment. Desnite the fact that more progress has been made in understanding and controlling diseases during the past century than in all of the previous centuries combined, many old diseases continue to defy control and new ones are continually appearing (10).

It is becoming increasingly evident that plant diseases are very shifty enemies and that fundamental researches are needed to elucidate their complete nature and to learn how best to counteract their deleterious effects. The fact that diseases still cost many relatively advanced countries like the U.S.A., Britain, China many millions of Naira a year is eloquent testimony that much more must be learned about their nature and control. And the need for control is far more acute in food-deficient countries than in those that now produce surpluses.

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FUNGAL DISEASES OF CEREALS IN NIGERIA

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Cereals are grain crops of the grass family (Gramineae) grown by man as food and feed for his animals. The cereals are the most important sources of plant food for man usually providing his stable diet. The grains of most cereals are used for production of beverages including beer and liquors. They are also industrially used for production of starch, alcohol and glues. The straw can be used as fodder for construction of houses.

The principal cereals of Nigeria are Rice, maize, and sorghum. Wheat, although not a tropical crop, is grown successively in the sahel savanna region of northern Nigeria.

Cereals like other plants in general are attacked by various pathogens causing verieties of diseases which may be of some economical value. The result of the disease may be expressed in reduction in yield of the affected plants, deformation of the plant or on retardation of its growth.

The pathogenic fungi are great enemies of cereals in Nigeria, contributing to their poor harvests. A good knowledge of these pathogenic fungi is therefore required for the maximum production of cereal crops in Nigeria.

Seed Rots and Seedling Blights

Many fungi can invade sorghum seeds and cause damage to the endosperm and embryo. Seed type with a soft endosperm are especially susceptible to invasion, and slight injury to the seed coat provides easy entry by pathogens. Numerous fungi have been isolated from sorghum seed, but those most commonly found and believed to be responsible for most rots are species of Fusarium, Penicillium, Rhizopus and Aspergillus. Their entry is faciclitated by cracks in the seed coat, although there is some evidence that direct invasion may occur in some soft-seeded varieties. Species of Pythium (especially in cold soils) and Fusaruim are two most important soil-borne fungi associated with poor emergence (Tarr 1962). The seedling may be attached at soil level with the result that it falls over as in the case of attack by Fusaruim moniliforme. Penicillium, oxalicum can attach seedlings even when they have reached the three - or four - leaf stage. Some species of Pythium and Helminthosporium are reported to cause similar symptoms. Coats of infected seedling have dark red elongated lesions, and upper portions of plants are often stunted and become chlorotic or purplish or both.

Root and Stalk Diseases

Charcoal rot is caused by Macrophomina phaseoli (Marble) Ashby. This fungis can cause a complex of symptoms in sorghum including seedling damping-off, seedling blight, root rot, and dary rot of stalks (Tarr 1962). The fungus enters plants through roots and thereafter advances into the crown and stem where rot occurs.

Red rot is a stalk rot caused by Colletotrichum graminicola (Ces) G. W. Wilson, the fungus which is more commonly known for its assocation with leaf anthracnose. Initial infection appears to originate at or near nodes. Water soaked areas develop within stalks that are only noticeable externally if tissue near the nodes are affected. Infection may eventually encircle the entire stalk. Resistance to red stalk rot is the only practical method of control.

Fusarium stalk rot caused by Giberella fujikuroi (saw) WOL (Fusarium moniliforme) (sheld) has been reported to cause stalk rot and other damage to Sorghum in several countries including Nigeria. It is believed that the fungus makes entry through roots, moves through the vascular system during early stages of plant growth, and later attacks the pith (Tullis 1951 quoted by S. B. King). Tarr 1962 reported that sorghum which show some tolerance to charcoal rot are also tolerant to Fusarium moniliforme rot.

Other soil borne fungi implicated as causal agents of roots and stalk rots are Corticium rolfsii Curzi and Corticium solani.

Downy Mildew

Several downy mildew fungi have been reported on sorghum, but downy mildew caused by Sclerospora Sorghi Wilson and Uppal is the only one of significant economic importance. It is known to be a common disease of Sorghum in West Africa including Nigeria.

The source of Primary infection is soil-borne oospores which germinate and invade roots of seedlings. Systemic infection follows and plant becomes chlorotic. Infection can kill plants in the seedling stage. A white downy growth composed of conidia may spread to healthy plants and initiate a second, non systemic, local lesion, phase of the disease. Non systemic infection may continue for sometimes if climatic conditions are favourable and entire leaves may be killed by this aspect of the disease. Heavy secondary infection may cause a third phase of the disease which is systemic and characterised by streaking and general chlorosis of upper leaves as they unfold from the work. Inter veinal tissues become necrotic and leaf shredding follows. Systemically infected plants generally do not head but they may produce heads which are either partially or completely sterile. Seed borne transmission of Sclerospora sorghi is known to occur and is likely important in dissemination of this fungus over long distances.

Resistance to downy mildews is obviously the most practical method of control, although sanitation and crop rotation also have some merit in reducing initial infection.

Nigerian "Daura" race of Sorghum show some resistance for downy mildews Futrell and Wester, (1966).

Leaf Blight

Several species of Helminthosporium have been reported to infect Sorghum, but H. Turcicum Pass is the most common and likely the only one which causes severe losses. H. turcicum is reported in most sorghum growing areas and mild, humid weather favours disease development. Plant may be attached and killed in the seedling stage giving way to poor stands.

Leaf lesion are typically elongated. Lesion generally have pigmented margins with tan coloured centers which become dark grey to alive in colour due to the presence of and abundance of conidia. The incidence of leaf blight can be partly controlled by resistant varieties.

Sooty Stripe

Sooty stripe is caused by Ramulispora sorghi. The disease has a world wide distribution, but is usually more severe in areas of high humidity. First symptoms are water soaked spots which may become coloured by host pigments. Lesion first contain sporodochia which bear conidia and later superficial sclerotia appear which can easily be brushed off. The characteristic sooty appearance caused by sclerotia, generally on the lower surface of leaves, gives the disease its common name and can be used to distinguish this disease from leaf blight.

Resistance varieties are the only control. Futrell and Wester 1966 in their work against a natural epiphytotics of the disease in Nigeria, found that about 5 percent of the 2700 world Sorghum enteries were resistant.

Another species of Ramulispora is the R sorghicola Harris, which causes a commonly occuring leaf spot in Nigeria (Harris 1966) which has been found on material from other parts of Africa and Asia (Tarr 1962). Lesion rarely exceed 4 mm in diameter, have red or tan bordin and usually carry a few sclerotia which are scattered over the straw-coloured central portion of lesion. Observation at Samaru indicate that this disease does not occur commonly as sooty stripe on entries of the world sorghum collection (King 1975).

Other Sorghum diseases of fungi in Nigeria includes rough leaf spot caused by the fungus Ascochy ta sorghina (Sacc) and has been reported to occur in most countries where sorghum is grown (Tarr 1962). The fungus causes circular leaf spots generally eight coloured or reddish and may not have distinct borders. Very little is known about resistance to this disease. At Samaru, Nigeria, a considerable amount of variation in reaction to this disease has been observed in the world sorghum collection.

Rust (Puccinia purpurea) occurs in Nigeria, but not usually important. It is found on the under side of the older leaves. Primary Inoculum arises as aeciospores on alternate hosts. Puccinia oxalis, and secondary spread may continue by means of Uredia. Host pigmentation usually appears around postules. Teleospores may or may not develop adjacent to uredia in postule.

Grey leaf spot of sorghum is caused by Cercospora sorghi Ell and Everh and is wide spread in countries with warm and wet climates. Characteristic symptoms are narrow lesions, somewhat restricted by veins which may reach 2 to 3 cm in length. Infection observed in Niger is most common on leaf blades but may also occur on leaf shealth and upper portion of stem.

Rice (Oryza sativa)

Rice is an important cereal crop in Nigeria. It is produced all over the country.

One of the fungal diseases that attacks rice is the blast disease. The disease is caused by Pyricularia oryzae and it is widely distributed in almost every area where rice is grown commercially. The disease affects all aereal parts of the plant. It is most conspicuous when it attacks the leaf's blade and the neck, but it is also found on the leaf shealth, rachis, the joints of the culm, and the glumes.

Damage is most serious when the neck region of the flowering stem is attached. The blast lesions appear at or near the uppermost node where greyish-brown necrotic areas are formed, later becoming black, the tissues of the stem rot, and the panicle falls over, giving the typical broken neck phase of the disease.

Blast is generally considered to be the principal disease of rice owing to its wide distribution and its destructiveness. Early infection often results in death of the affected plants. Panicle infections tends to reduce yield.

The fungus can be seen on leaf spots and other affected areas as greyish or grey-green mouldy coating. Individual conidia are almost hyaline to pale olive, obclarate or pear-shapped, tapering at the apex, with two septa. They are borne on simple conidiophores and are readily detached and dissemated by air movement.

Methods of use in controlling blast are the use of resitatnt varieties, cultural methods, and the application of fungicides; a combination of these methods would normally be used. Seed treatment with benomyl 20% a.i. + thiram 20% has replaced mercuric seed treatments and is active against Pyricularia, Gibberella, fujikurai and Cochliobolus. Antibiatics used in control of blast include blasticidin - and Kasugamycin. Edifenphos is also effective on blast.

Brown spot disease of rice is of great importance in all rice-growing countries; Asia, America and Africa including Nigeria.

The fungus causing brown spot is Cochliobalus miyabeanus (Sphaeriales). The imperfect stage is Drechslera Oryzae. The fungus causing brown spot is capable of affecting the coleoptile, leaf blades, leaf shealths, and glumes but is most commonly seen on the leaves. Spot first appear as minute brown dots, later becoming ellipsocdal or oral to circular with, when fully developed, a light brown, fawn, or grey centre and dark or reddish brown margin. Yellowing leaves and die back may also be a symptom. The disease is seed-borne and seedlings grown from infested seed become blighted. The disease can cause heavy losses.

Spores germinate, under favourable conditions, within a few hours and form hyphal which penetrate directly through the cuticle and epidermis, or through the stromata. The fungus may survive for two to three years in infected plant parts, particularly the seeds, and it is from infected seeds that the disease often starts.

The incidence of brown spot is closely correlated with mineral nutrition; careful use of fertilizer can do much to prevent the disease. Application of open-health furnance slag containing silicon, iron, magnesium, mangenese and phosphate is effective in controlling the disease. Resistant varieties offer the best means of control. As the brown spot fungus is seedborne, seed treatment with fungicides in several countries. Preliminary investigations in Ibadan, Nigeria have shown that mancozeb 80% a.i. (ag/1/10m^2), blasticidin - s 4% a.i. (Ig/1/10m^2) and thiram 65% a.i. (23/1/10m^2) have good potential as foliar sprays for the control of brown spot. The antibiotic polyoxin A is very active against this disease.

Stem rot and irregular stem rot of rice are caused by Magnaporthe salvinii and Helminthosporuim signoideum veriety irregulare.

The symptoms of both diseases are very similar. The main differences is that the sclerotia of H. segmoideum var. irregulare are irregular with rough surface whereas those of M. salvinii are spherical with a smooth surface.

Stem rot is one of the more serious rice disease as far as yield losses are concerned and can be second to blast in its severity. The disease is also influenced by the nutrition of the rice plant, excess nitrogen favouring attack especially if applied early.

The control measures against both stem rots are by rice of resistant varieties. Fungicides are not widely used for control the disease. As the fungus perennate in plant remains, burning off the stubble and straw left in the field after harvest is an added precaution.

Damping off disease of rice is caused by several species of water moulds, the main ones being Achlya spp. and Pythium spp. other organisms causing seedling diseases include Fusarium spp., Helminthosporuim oryzae, Rhizoctonia spp. and Corticium rolfsii.

Various fungicide treatments have been evaluated for control of seedling diseases. Captafol and captan need treatments have been reported to give good control of Achiya Klebseana and Pythium spp.

MILLET

Millet is a cereal crop of the thirst regions, maturing quickly. It is grown mainly in the Sudan Savanna, Sahel Savanna and high Plateau of Nigeria.

The major millet diseases in Nigeria are downy mildew or green scar, smutandergol. The downy mildew is caused by the fungus Sclerospora graminicola. The loss from this disease is about 10% in yield. The affected plants are pale green and covered by downy white growth. Panicles turn into leafy structures resulting in complete sterility. It is a soil borne disease and the degree of infection depends upon soil and atmospheric moisture. The only effective method to control the disease is to develop resistant varieties.

Smut is caused by Tolysporium penicillarie. The flowers become infected before the appearance of the stigmas. The infected grains show the characteristic features of the smutted grain. No control measures are available. Ergot is caused by Sphacelia microcephala. The disease is not serious but it causes extensive losses in some years. The fungus attack the developing grains. Fungus masses replace the grain and produce a pale brown honey - dew - like secretions which after turn pink. The secretion is passonons. No method of control is known other than use of resistant varieties.

ZEA MAYS

MAIZE (or Indian Corn) is an important cereal crop in Nigeria and one of the main food plants of West Africa. The maize plant is a native of the Americans.

The major disease of Zea Mays includes leaf blight caused by Helinthosporium turcicum, southern leaf blight caused by Helminthosporium maydis and leaf spot caused by Helminthosporium carbonum.- This fungal disease attack the leaves resulting in considerable wide leaf spots. These necrotic spots on leaves lead to reduction in photosynthsis during grainfilling (Jones 1976). Two types of Rust disease of maize are recognised all over West Africa. Puccinia sorghi, a rust of West African origin, causes little damage. P. Polysora, a central American species which appeared in 1950 from Upper Senegal and quickly spread through tropical Africa was more serious but has now lost its virulence. The use of resistant varieties and early planting are the best means of combatting it.

Corn smut is caused by Ustilago maydis. This fungus affects the leaves, stems, tassels and cobs, their tubers of black spores bursting and spreading.

Generally only individual plants are affected. Infuted plants should be burnt immediately. Seed selection is the only means of preventing its outbreak.

Wheat (Titicum) sp.

Wheat has been traditionally cultivated in Sahel and Sudan Zones in northern Nigeria for an unknown length of time.

Stem rust caused by Puccinia graminis sp. tritici is one of wheat diseases of great concern in Nigeria. Andrews (1968) reported two appearance of stem rust of wheat on the 1962-3 crop at Hadejia and in the following year in Sokoto. At Hadejia however about 70 percent of the farmers' crop, all planted with the local variety was lost. At Sokoto the attack came very late and caused little loss.

Brown leaf rust (Puccinia recondita) is frequently recorded, mostly on the late plantings, but it never reaches epidemic proportions. Andrew (1968) again observed loose smut (Ustilago tritici) of wheat once on an introduced variety in its first season of growth, but strigent sanitary measures prevented the smut from establishing itself.

Cereals are major food crops in Nigeria. A thorough understanding of the main diseases which are of economic importance to this crops will increase their yearly yield. Effort should be intensified to investigate those diseases which are common to almost all the cereals. Rust caused by Puccinia graminis and leaf blight spots caused by Helminthoporium spp. are the examples. A good understanding of these common diseases of cereals will widen the insight into the system of inter-cropping of the cereals by the local farmers. The best control of the fungal diseases of cereals appear to be that in which resistant varieties are employed. As larger number of Nigerian farmers are still poor, any chemical control of the diseases, when discovered, should be as cheap as possible.

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CONSERVATION AND MANAGEMENT OF NIGERIA'S SOILS

by

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Soil has genetic and functional definitions. It has many uses and so its functional definitions are many and varied.

As relates to Agriculture, it can be defined as "the medium in which water, air, heat and light work together to allow plants to grow". Apart from being a source of nutrients for plants, it also provides mechanical support.

It is a very important natural resource on which the life of mankind directly and indirectly depends, plants being a source of food, fibre and shelter which are some of the basic necessities of life.

Soil, unlike air and water which circulate and are only scarcely temporary if at all, especially in the case of air, is highly destructible. The causes of destruction can be both naturally and artificially induced. The effects of the natural causes, except in occasional cases of e.g. earthquakes, are generally insignificant because under the natural conditions, a state of dynamic equilibrium is reached at which level the soil can still be very "productive". Man's activities, in the struggle for existence, disturb this state of equilibrium resulting in its destruction. These activities increase with the increasing world population. Only about 30% of the earth's surface constitutes the continents. A large part of this cannot be used because of inaccessibility.

I have so far been trying to point out the wrong impression by many people that the world's and especially Nigeria's soil resources are unlimited. If man is to survive, whatever remains of our soil resources must be preserved and if possible, restore those already damaged.

Soil conservation involves everything done to preserve the soil for a high and prolonged productivity. It is essentially good soil and crop management and embraces more than just the prevention of soil losses by erosion. Consciously and unconsciously, soil conservation is accompanied by water conservation. Soil conservation also includes such practices as irrigation, land drainage and reclamation of saline/sodic soils. Of course, a soil can be conserved for non-agricultural uses.

The causes of destruction and loss in value of the soil for agricultural purposes are:

(a) Soil Erosion: which is the physical removal of soil particles which also involves loss of nutrients. Of all the various types, the most serious that affect agricultural value of the soil and the most prevalent but least noticeable is sheet erosion by which the topsoil is removed. The most noticeable is gulley erosion which is very common on the Jos Plateau and very spectacular in the Agulu-Nanka area of the Anambra State and in Imo State. Details of the various types and the processes of erosion are out of context here.

(b) Soil degradation/deterioration by which I mean the destruction of the structural aggregates of soils. In some cases, it precedes erosion. The movements of water, air and heat in the soil are affected. Root penetration can also be adversely affected.

(c) Loss of nutrients in the soil through erosion, leaching, crop removal with harvesting and/or burning.

Such phenomena as flooding and salt accumulation in soils render them useless even if only temporarily.

The factors that affect the above phenomena are, as said earlier, natural and man-induced. They will now be discussed as they occur in Nigeria.

Natural Causes:

Some of the natural causes are climatic and relief factors. The climatic factors are rainfall and wind. Rainfalls are generally very intensive. They cause erosion and in the case of rainfall, also leaching. Nigeria can be divided roughly into three zones in this respect: (1) the South where rainfall is very heavy and also along the coast where tidal effects can cause a lot of erosion; (2) the so-called middlebelt where the rains are still relatively heavy but with 5 - 7 months dry period and so wind erosion also occurs; (3) the Northern Sahel Savannah zone where rainfall is scanty and the main agent of erosion is wind.

In the South, vegetation is generally forest which offers protection against erosion but the Agulu-Nanka areas, are under very intensive cultivation through which the vegetation is removed and these, combined with the sandy and hence porous nature of the soil and the undulating relief, make the area very susceptible to serious erosion. On the plateau too, rainfalls very torrential and the relief is rugged. The high amount of rainfall sometimes results in flooding in these areas.

In the middle-belt the vegetation is reduced to secondary forest mixed with grassland. There is also intensive cultivation. These cause exposure to the influence of rainfall and wind.

In the North, the scanty rainfall does not allow the growth of enough vegetation cover and this in addition to the generally sandy soils make them (the soils) very susceptible to wind erosion. Salt accumulation in soils is associated with arid and semi-arid regions.

Man-induced causes:

(a) The indescriminate clearing and burning of bush and forest which are characteristic of the system of farming in this country expose the soil to the hazards of rain and wind. Soil erosion and degradation are enhanced. Leaching of nutrients and loss through burning occur.

(b) Overgrazing as it occurs exposes the soil having the same effects as outlined in (a) above.

(c) The common practice of removing all the crop and crop residues also exposes the soil with the attendant problems.as above.

(d) In some parts of the country where mining takes place (e.g. the plateau of the Plateau State) a lot of agricultural soil is exposed and destroyed. It takes years to restore the soils in these areas.

(e) The making of unconnected mounds in our farming system allows free surface movement of water in between them thus causing erosion. In some cases when ridges are made they are made along the slope and this enhances erosion.

The problems enumerated above resulting from the farming practices do not mean that our farmers are completely mindless of their environment. If nothing else, they know when their crops yields start decreasing and so they "shift" to another place. This is "shifting cultivation" or "land rotation" which some schools of thought condemn but which has its own advantages under certain conditions. The soils are left to regenerate.

Scattered here and there in the country, one can observe terraces constructed long before the advent of modern agriculture. Shadoof irrigation is still being practised along streams especially around townships where fruits and vegetables are grown.

The so-much-talked-about minimum or no-tillage system has been in practice in the sandy and flat areas of the northern part of the country.

The government has been aware of the problems and the needs for soil conservation as far back as the fifties especially in the former northern and eastern regions of Nigeria. Even now, some state governments have soil conservation section of the Ministry of Agriculture. The Federal Department of Agriculture has the Land Resources Division which is charged, among others, with the responsibility for soil conservation in the country. A large sum of money is voted every year for soil conservation by the Department. Prefeasibility surveys of the Agulu-Nanka disaster areas had been done and work is at the design stage in the area now. One of the major constraints to the development and progress of soil conservation in the country is shortage of manpower. The most crucial cadre of staff are the junior and the middle which are needed in greater number to be on project sites than the high level calibre of staff. It is with this in mind that the Federal Soil Conservation School, Jos was established in 1969 by the Federal Ministry of Agriculture in conjunction with the USAID who phased out in 1972. It started by training junior level manpower but in 1973, it started training the middle level manpower with a diploma certificate in Agriculture, specialising in soil and water conservation. A comprehensive course in basic soil science, soil management and engineering aspects of soil conservation is taught. Of course, the school has faced and still facing its own problems especially of shortage of teaching staff and lack of space for expansion to meet the increasing demand on it by the state governments, the newly created River Basin Development Authorities, the universities and private organisations. A site has been acquired however and efforts are being made to develop it soonest. However, it will still take time for it to be able to satisfy all the manpower needs in this field. Some of our universities like UNIFE and ABU now offer courses in soil conservation and related disciplines even at the postgraduate level. They will provide the high level manpower needed.

One other major constraint is the relatively little or no education of our farmers who unfortunately are also peasant and so cannot afford the expenses of some of the conservation practices required in some places. Associated with this is the shortage of manpower in the field of exension which is an agent of education of the farmers.

Our social and economic systems also constitute a problem. Some soil conservation practices, for them to be economically applied, need to be applied on a large scale. The land tenure system whereby land is owned in some places by individuals or groups of individuals prevents this large-scale application of these`soil conservation practices. Exaples of these expensive practices include construction of terraces, diversions, watercourses and sometimes dams and ponds for the storage of water.
Apart from the relatively high cost, they require a highly skilled knowledge for the design, construction and maintenance. This does not mean that there are no simple soil conservation principles and practices that our farmers can easily understand and apply. Examples of such practices are:

(a) Crop management which includes:
  - (i) plant residue management
  - (ii) weeding at the right times
  - (iii) crop rotations
  - (iv) strip cropping
  - (v) mixed cropping

(b) The no-tillage or minimum-tillage techneques of cultivation.

(c) Controlled livestock grazing.

(d) Contour ridging.

(e) The use of fertilizers and other chemicals like pesticides and herbicides.

Conclusion:

The large size of the country, the magnitude of soil conservation problems are such that the country still has a long way to go.

Soil conservation programmes have to be tied up with soil, hydrologic, soio-economic and biologic informations. These informations are scanty. Where some are available, they are hoarded. However, a start has been made. Success only requires dedication and honesty of purpose in all our duties and planning processes. I wish you continue to organise yourselves as at now and in future to contribute your honest quota in preserving this all-important natural resource - the soil. If and when our oil dries up, the soil is what will remain for us to fall back on.

CONSE[illegible]ON AND MANAGE[illegible] OF NIGERIA BIOLOGICAL RESOURCES

by

[illegible]. SHA,
Princip[illegible] [illegible]ild Life Officer,
Zo[illegible]ical Gardins,
Wi[illegible] Life Unit, Jos.

What i[illegible] Biological Resource? One may define a biological resource as that which o[illegible] has access to and provides a means or an ability to meet and handle a situation - a biological stock that can be drawn on.

Biological resources may be calssed as follows:-

1. Non renewable resources which go with continuing exploitation e.g. coal, oil and gases.
2. R[illegible]able resources which though can be threatened to extinction by ov[illegible]r-exploitation or destruction through agriculture and set[illegible]ments as happens when forests/habitats are destroyed - are nev[illegible]theless renewable, examples: plants and animals.

THE NEED FOR CONSERVATION

As for non renewable resources, there is very little man can do by way of conservation. It is a sure thing that these have to be exhausted at some stag[illegible] [illegible]th use - no matter how well planned the exploitation or extraction m[illegible] b[illegible].

In the case of the renewable resources, only unplanned or over-exploitation may threaten or lead to extinction otherwise renewable resources are here to stay or to last ind[illegible]initely.

Conservation of the biological resources then is an attempt to preserve or maintain the renewable biological resources so that present and future generations may also have access to them.

If you s[illegible] ask the question why conserve at all? Then I have this to say:-

(a) So[illegible] once put it that "every living thing on earth is unique, once gone, it may never be replaced, it is a part of what Sci[illegible]sts call the genetic pool" the great reservour of life on [illegible]th. Evolutions and unknown combinations and mutations of gen[illegible] within that reservous will certainly produce forms of life in [illegible] to come that we cannot know about now - conserve to maintain the genetic pool.

(b) Recreation: Wildlife and parks have become good places for relaxation from the dirty, noisy, busy city or town life - in fac[illegible] wildlife centres have become the sign of quality in our env[illegible]ent. Not very long ago Penicillium mould was simply rega[illegible] as that mould found on bread, but today it is man's sup[illegible] blessing in the field of Medical Science. On the other hand, the fruit fly *Drosophila* was once just another wild organism but it is today invaluable in genetical studies. The guinea pig which was but just another wild animal is now invaluable as a crucial ally in man's war against disease.

(c) Posterity - It should be a matter of pride for past and present generations to leave behind for our grand children what nature left here for us or endowed us with. It would be very criminal of us not to leave behind anything, if not all.

(d) Economic - Many long-term economic advantages may be derived or gained through wildlife conservation by way of:-

(1) TOURISM - Foreign Exchange
(2) PROTEIN - From game cropping
(3) TIMBER - From Forest Produce.
(4) LIVE ANIMAL TRADE - Foreign Exchange
(5) HUNTING - Foreign Exchange
(6) BUSINESS AND EMPLOYMENT - Firearm/amunition?
Photography, Transport, Shop, Hotels Tropies.

The question now is how do we converve biological resources? As stated above the renewable biological resources (Fauna & Flora) can be threatened to extinction by unplanned or uncontrolled exploitation. As would be the case when large-scale destruction through bad agric practices and settlements, when forest or habitats are destroyed without thought of replacement - thus preventing the development of forests and other habitats. Over-fishing and over-hunting may also lead to extinction of animals.

To conserve, therefore, would mean an attempt to eliminate all the threatening factors. To do this:

1. the bush land or habitat is defined and demarcated by a cut line.
2. An attempt is made to make laws that would discourage over-exploitation thus a measure of protection to the plants and animals in their habitat.
3. An attempt is made to enforce the laws so made thus stopping transgression and enchroachment.

For some areas, these three are all that may be required. But in most cases more positive protective measures by way of proper effective management plan would have to be drawn and implemented. This positive management plan would involve:-

Positive Management

A. Inventory: to find what species of wildlife (plants and animals) are present, what the geographical and ecological distributions of these species are and their food cover and water requirements; what seasonal changes do occur in the distribution of the plants and animals.

B. Census: to find out how much wildlife is present, how much habitable and productive wildlife environments there are, how much food, cover, and water requirements and their distribution.

C. Yield determination: to determine or assess annual or yearly production of the plants and animals - assess annual increase in wildlife in relation to their food/cover requirements.

D. Diagnosis: Interpret what is wrong with productivity before concluding whether the wildlife populations are all that they should be or that they are something other than they should be.

If production is something other than it should be, then the explanation must be sought in the environment. Diagnosis may then involve the following three steps.

1. Recognition of the factors operating against the various species.
2. Evaluation of the effects of these factors.
3. Choosing the limiting factors.

E. Control: What is to be done as a result of the outcome of the diagnosis; and involve environmental manipulation or modification and manipulation of animal numbers - thus a thorough knowledge of the environment is of primary importance.

Nigerian Problems of Wildlife Conservation and Management

It is well to recognise that the entire economy of the nation is connected with the uses to which the land is put. It is also well to recognise that those lands suited to the production of life necessities will be used for the production of these necessities.

Wildlife Conservation/Production will be secondary except where the value of wildlife exceeds the values of other potential forms of land uses. Thus the existence of wildlife depends on the present and future land use, and this in turn depends very much on the future population trend.

Thus before any serious consideration is given to conservation and utilization of wild resources of an area, its place among other forms of land use must be weighed alongside socio-economic considerations, to discern whether a given type of land in a given area is being used to the best advantage. It is essential to know what it is capable of being used for and how much of it there is in the area and in the country.

This requires a comprehensive survey of land capability and use, specifically designed as a basis for land use and resource planning for agriculture, forestry, mineral exploitation, recreation and wildlife.

Do we have such a set up in the country?

Other conservation problems stem from the fact that for wildlife conservation to succeed or survive, we must be able to show in concrete terms that conservation pays, that wild resources are bringing and will continue to bring economic returns, otherwise competing economic land use will gradually reduce the resource and endanger their future.

This gives rise to the problem of how to make biological resources and areas contribute maximally to the nation's economy without adversely affecting the conservation of the resource.

There is the need to educate the ignorant public on values of biological conservation. Since most of the people concerned live in the remote rural areas, education by the T.V., News papers, radios and posters may not as yet be effective.

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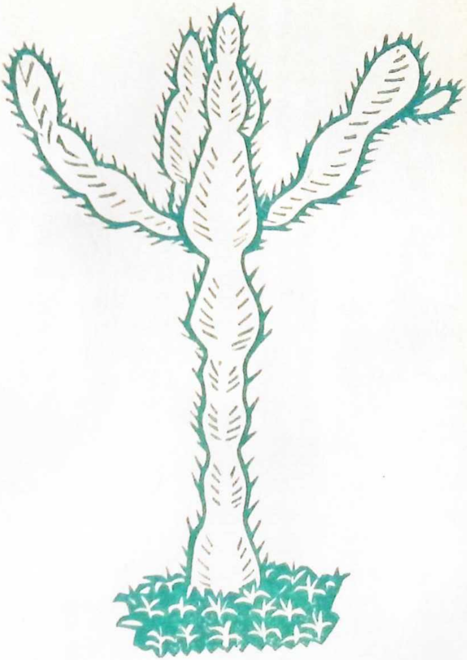
EUPHORBIA



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CORRIGENDUM

AT PAGE 18, DR. K. GEORGE WAS MISTAKENLY REFERRED TO AS LECTURER IN THE DEPARTMENT OF BOTANY. DR. K. GEORGE IS INFACT, A SENIOR LECTURER IN THE DEPARTMENT OF BOTANY.

EDITORIAL COMMENT

The year 1978 was an important milestone in the history of the Botanical Society, University of Jos, Nigeria, because it witnessed the birth of the "EUPHORBIA," the annual journal of the Society. The first and second issues were of high quality and I have no doubts that this issue will offer even more reading pleasure.

With pleasure the entire members of the Editorial Board join the student body of the Botanical Society to pay tribute to our former Head of Department, and Grand Patron, Professor G.K. Berrie who left us for his home country. As Grand Patron, he was a source of inspiration to us and did everything possible to encourage the production of the "Euphorbia." We are happy that the new Head of Department is giving us maximum cooperation and is in fact exerting himself to see that the Botanical Society retains its enviable position amongst other student organisations. The "Euphorbia" was created to be a forum for promoting the exchange of Botanical ideas between students and staff of the Department of Botany, and for stimulating and encouraging students of Botany and Biology in the art of reading, research and writing. It is also to be a means of informing the reading public about the roles and contributions of the study of Botany in the Society. I feel particularly happy about our achievements over the years because, the "Euphorbia" has improved both in quality of materials published, in the quantity produced and in its circulation. I t is my pleasure to inform the public that, the "Euphorbia" has now gained an International Recognition with the Nigerian National Serials Data Centre, Lagos, assigning it an International Standard Serial Number, ISSN: 0331-7994. We are indebted to the various people who made these achievements possible. The articles in this issue, still cater for various shades of Botanical interests. I hope you will benefit immensely from the information contained herein, since they hilight the results of the works of eminent and thoughtful scientists.

ACKNOWLEDGEMENT

I am grateful to all those who have contributed manuscripts to this issue. My indebtedness goes to our Advisers Drs. C. O. Akueshi and P. G. Abraham, who after reading the initial manuscripts, furnished us with good comments, corrections, and suggestions. I am most grateful to those Companies who advertised in the "Euphorbia" for their financial support. I also owe special thanks to Mr. Fapuhunda, S.O. the former Editor, for his willingness to take time

on numerous occasions to discuss with me special problems on the publication of this issue. It is also with great pride that I commend our Honorary Life Patron - Mr. Jack Tilley Gyado for his keen interest and munificence to the Society. He is no doubt, single-handedly, the greatest sustaining associate to Botanical Society, University of Jos.

From our readers, I shall continue to welcome suggestions which may help to improve the quality of subsequent issues.

THANKS.

AKPAN, IBANGA UDO
E D I T O R.

GRAND PATRON'S ADDRESS

I consider it my proud priviledge to present this grand patron's message for inclusion in the third issue of EUPHORBIA, being published by the Botanical Society of University of Jos. The Society maintained a fairly high standard for the two periodicals it has already issued , and I am confident that this third issue will still be of a high standard.

The enterprise shown by the Executive members of the Botanical Society is quite appreciable. In the same vein, I feel greatly impressed by the enthusiasm, cooperation and honesty of purpose of the members of the society. Their coordination and harmonial cohesion with the staff of the Botany department reflects upon a good omen for the bright future of the study of Botany in this University.

The Botanical Day for the 1978/79 academic year was celebrated in a highly sophisticated and dignified manner. The quality of participation in the function was quite high and the appreciation exhibited by the participants and guests was manifested both verbally and financially.

It is my pleasure to communicate to the readers of the periodical that three Pioneer members of the Society completed their under-graduate studies quite satisfactorily and they have gone to serve the nation with the zeal, wisdom and the aptitude for knowledge they acquired at University of Jos. We feel proud of their performance and congratulate them for the marvellous success they have achieved. They were highly honoured and given a splendid send-off by the society.

The prizes so generously sponsored by Mr. Jack Tilley-Gyado were awarded to the Botany students on the basis of their excellent performance at the time of the university convocation. It was a unique opportunity which was greatly appreciated by the authorities, The University Authority expressed deepest sense of gratitude to Mr. Jack Tilley-Gyado for sponsoring the award.

While concluding this message, I wish that the Botanical Society and Department of Botany, hand in hand, gain strength in 1980 and in the years to come.

DR. C. M. YAQUB
AG HEAD OF DEPARTMENT.

A CITATION ON MR. JACOB TILLEY GYADO ON THE OCCASION OF THE CONFERMENT ON HIM OF THE LIFE PATRONAGE OF THE BOTANICAL SOCIETY OF THE UNIVERSITY OF JOS

by

The Botanical Society Orator 1979,
MR. FRANK KOLA ODUNLAMI

Mr. Chairman Sir, Vice-Chancellor, Honourable Commissioners, My Lords Your Highness, Distinguished guests, Ladies and Gentlemen, I present Jack Tilley Gyado.

Many share the view that great men are born, some believe that greatness is trust upon men but many schools of thought hold it that men achieve greatness. But indeed great men are known by their great dee

It is a matter of orthodoxy, and in fact, befitting and right that honour should be bestowed on this industrous and illustrous Nigerian for his services to the community in which he lives.

Mr. Jack Tilley Gyado is the son of one of Nigeria's most successful businessmen Mr. Joseph Tilley Gyado. He was born under the lucky star of SAGITTARIUS on 15th December in the year of our Lord Nineteen hundred and fourty four and after a successful primary education, he had his secondary education at St. Michael's College Aliade between 1958 and 1962. From 1964 to 1965 he read for his advanced level papers at the Federal School of Science, Lagos. Mr. Jack Tilley Gyado was not carried away by his rich parental background. He realised the essence of self endeavour and went in for a University education. He was a student of the Ahmadu Bello Univerity, Zaria from 1966 to 1969 where he came out as one of the first five graduates of that institution in the Department of Botany. After his University education, he served as a Leaf Research Manager with the Nigerian Tobacco Company from 1969 to 1972. Indeed, Mr. Jack Tilley Gyado is a botanist by upbringing and interest, and helped in tobacco production and research in the Leaf Department of the Nigerian Tobacco Company, Zaria.

"Diversity enhances stability." In 1973, Mr. Jack Tilley Gyado joined the Tilley Gyado Organisation as the Group Managing Director and in 1974 he attended the University of Rome under the auspicies of the United Nations Organisation. Here he obtained a Master's degree in International Management.

I think, it was a Contemporary Philosopher who said "Men who want their names immortalised should always endeavour to do so either by their remarkable contributions to their immediate locality, distant environs or to mankind at large." So it was then in the year of our Lord Nineteen hundred and seventy five, that Mr. Jack Tilley Gyado established two colleges namely, The Tilley Gyado College, Makurdi with over 1000 students and the Tilley Gyado College, Ihugh with over 500 students. In these two Colleges he laid emphasis on the study of science with Special Stress on Biological studies. Being a lover of his profession, Mr. Jack Tilley Gyado established two parge farms at Agasha and Kebbi near Makurdi in the same year, 1975 to promote Agricultural Practices.

It is worthy of mention that Mr. Jack Tilley Gyado is a member of many learned societies - Member of the Institute of Biologists, London; Member of the British Institute of Management; and an Associate Member of the Nigerian Institute of Management.

It is our hope that he will be the first Nigerian to establish an indigenous Botanical Garden in Nigeria. The importance of such a venture in terms of knowledge and materials cannot be overemphasized.

Since the inception of the Botanical Society, he has shown very keen interest in the society and has made outstanding contributions towards the growth of the society and the enhancement of Botanical studies.

Mr. Jack Tilley Gyado is an indefatigable philanthropist - he has, to his eternal glory immortalised his name in the University of Jos by being the first Nigerian to award academic prizes for the best Three Third Year Students in Botany. By all standards, ladies and gentlemen, this is an account of a man who is committed to the welfare of his people and mankind at large. It is therefore in recognition of his interest and contribution to the well-being of his fellow Nigerians, and the advancement of Botanical knowledge and his keen interest in the Botanical society, University of Jos that this society has deemed it fit to confer on Mr. Jack Tilley Gyado the LIFE PATRONAGE of the Botanical Society, University of Jos.

Mr. Chairman Sir, it is with profound pleasure, therefore, and by the authority of the Executive and entire members of the Botanical Society of the University of Jos, that I present Mr. Jack Tilley Gyado, a Botanist, now turned Business Executive, a distinguished citizen, a charismatic and respectable gentleman, a friend of the community and Philanthropist for the Conferment of an Honorary Life Patron of the Botanical Society, University of Jos, Nigeria.

FROM THE PRESIDENT'S DESK

As the third volume of our annual journal "EUPHORBIA" is ready for circulation, I deliver my Presidential Message with great joy, for it has become a success inspite of overwhelming initial difficulties. It was in February, 1978 that the maiden issue of "EUPHORBIA" made its remarkable appearance as the first academic journal in this University. Among other aims, "EUPHORBIA" is designed to broaden a layman's scope of knowledge and also to stir up a genuine sense of obligation to the Nation, in would-be and already full time Biological Scientists by gearing their efforts towards meaningful research work.

In pursuance of such goals, I call on all Botanists, in all institutions, to make tremendous impact in the advancement of Nigerian Technology as one could specialise as a Mycologist, Phycologist, Geneticist, Ecologist, Bacteriologist, Paleobotanist, Plant Physiologist, Plant Anatomist, Plant Taxonomist, Plant Pathologist, Plant Biochemist, Plant Breeder, Wood Technologist, etc. Thanks to the Federal Government of Nigeria for creating the Ministry of Science and Technology, which would sponsor and co-ordinate research projects. And I strongly believe that meaningful outcome of the research work would be a necessary launching pad for a successful technological take-off.

Our new students, you are whole-heartedly welcome to the Department of Botany. According to Professor Alfred Whitehead, "A good education should help the student to understand man and the world and also equip him to do some worthwhile job." Definitely, as you will soon find out, the department in conjunction with other departments runs a good programme designed to prepare and equip you for the role you are expected to play as Botanists. I wish you success in the great task of grazing in this intellectual green pasture. And as you battle with your academics avoid being socially amputated by allowing the academic work insulate you from the activities of the Botanical Society.

The students and staff have been living amicably in our department. Indeed, we shall count ourselves lucky for having such humble and hardworking intellectuals as our lecturers. We reap benefits as hybrids resulting from intellectual cross-pollination between the students and the staff. May this cordial relationship grow from strength to strength. To our dedicated Head of Department Dr. C. M. Yaqub, we pledge our unequivocal support in your effort to build an academically and socially strong department. I say a warm welcome to our new members of staff and hope they will join us in the happy band wagon.

My congratulations go to my predecessor, Mr. Ataga, for his tireless effort in projecting the image of the society within and outside the University. To all of our final year students, May God crown your efforts with success in the fast approaching degree examinations. I must not end my message without conveying my special thanks to our HONORARY LIFE PATRON, Mr. Jack Tilley Gyado for his keen interest, moral/ and financial support to the society. May God reward him a hundred-fold. To the members of the Editorial Board and the Editorial Board Advisers, your work is impressive beyond adjectives.
Accept my simple congratulations. And to everyone who has contributed in one way or the other in making this publication a success, I thank you all. Finally to our readers, this third volume of "EUTHORBIA" is ready for your consumption. Have a nice time reading it. I hope you will enjoy every bit of it.

LONG LIVE THE BOTANICAL SOCIETY OF UNIJOS!!!

CLETUS CHIJIOKE ONYEBUCHI
PRESIDENT, 1979/80 SESSION

FOREST PRODUCE CONSUMPTION IN PLATEAU STATE WITH PARTICULAR REFERENCE TO JOS

by

Asemota S. E.
3rd Year Botany Student

The present consumption level of forest products in Nigeria is expected to double by 1985 and demand will become more difficult to meet owing to diminishing yield from the forest. Consequently, wood use should be rationalised to reduce the amount of wastages and losses occuring as a result of agencies of wood degeneration. Possible means of improving productivity should include correct selection of species and provenances breeding of highly yielding trees, good tending, use of fertilizer and choice of the best rotation to supplement the the natural out-put.

Plateau State lies within the Sudan Savanna Vegetation of Nigeria; and Jos Plateau is situated 10°N and 80 50°E at an elevation of about 800 metres. It is preserved as a highland area by granites intruded into the metamorphic rocks of the Basement complex which in many places are covered by basaltic flow. This edaphic factor only supports Savanna species from which a large population of the forest produce would be expected to come in this Savanna area. However this region is not endowed with timber rich forests and the productivity of the natural vegetation is extremely low. Results from research improved Silvicultural techniques in recent years indicate that these savanna species may eventually produce the wood to meet the need of the local population of Jos.

Forest is used in many different ways. Wood came out of forest and wood product market provide principal markets for the output from industrial plantations.

FIRE WOOD YIELD:

In the savanna region of Nigeria almost all firewood consumed comes from indigenous savanna woodland, but at present the proportion supplied from Jos Plateau is very small. Fire wood is mostly used for cooking locally. It used to be scarce in Jos area but the situation has gradually improved because of the plantations which have been established by the State Forest Department, and the rural communities are able to satisfy most of their wood requirements from the surrounding savanna. This is not applicable to Jos City where firewood substitutes like coal and gas particularly kerosene have to be supplied.

With the new rate of gas price increase, firewood is preferred to the coal which has to be transported from long distance from Enugu and little is known about it in the rural areas.

In Jos, average firewood consumption per person in the low income group is almost the same as that of the middle income group. This is because firewood is comparatively cheap. The fast grown Eucalypts on the Jos Plateau cannot meet up this demand so most of the firewood used comes from other savanna areas and are imported from Bauchi, Gongola, Kaduna, Borno and wastes from sawn- wood.

PRICE:

The Jos Local Authority Department sells Eucalypts and other firewood by the cord at about ₦5.00 per store stacked in the bush in the vicinity of the town. The natives who display most of their wares along roadsides sell at fluctuating prices ranging from ₦2.50 to ₦7.00 depending on the size, season and the bargaining power of the buyer.

The species used for fire wood at Jos varies from herbs to trees. Savanna species are: Isoberlinia doka, Monotes Kerstingii, Terminalia avicennioides, combretum mieranthum, Khaya senegalensis, Albizia zygia, Phylantus discoides, Eucalyptus species, Ochna Afzelii, Anogeissus Leiocarpus, Hymenocadia Acida, Bridelia Ferruginea, Lophira Lanceolata, Trichilia Species, Vitex Diversifolia, Nauclea Lassifolia, Piliostigma Thoningii, Daniella Oliveri Zyzygium Guineense, Prospia Africana Isoberlinia Tomentosa, Parinari Curatellifolia, Parkia Clappertoniana and others.

Charcoal is a by-product in the afforestation projects in Plateau. It is used in Jos City as house-hold fuer, mostly by Blacksmiths. This is a small and shrinking market. Charcoal is generally sold in bags and it has been made in the forest area under the Jos Local Authority Forestry Supervisor. Rural Communities also supply Jos City. The price at which a bag of charcoal is sold at its market varies from place to place and apparently also from time to time. At Jos for example a bag is sold at ₦8.00 in times of scarcity especially during the rainy season and cheaper during the dry season.

BUILDING POLES:

Poles are required for transmission, roofing for building sheds and for some other purposes. Big building firms use poles for scafolding which is gradually being replaced by steel pipes. There is a small and shrinking market insignificant in comparison with the traditional consumption. Most poles were obtained from the palm borassus flabellifer by splintting the trunk of the palm lengthwise into a number of segments.

This is gradually being replaced by wooden poles from established plantations which are extracted at "Pole Stage."

As the traditional thatch or mud roofs are increasingly replaced by roofs of corrugated iron, building poles tend to be replaced by sawnwood rafters, yet the market demand for wooden pole is on the increase for fencing and other purposes. Survey carried out by the Federal Government with the assistance of the United Nations Development Programme (UNDP) Food and Agriculture Organisation (FAO) 1972 showed that Jos had an average consumption of 2,500 poles per 1,000 inhabitants per year.

SAWN TIMBER:

As the population of Plateau State increases the total annual consumpt of sawnwood for Jos beames higher. This forest product is very essential to life, therefore there is a ready market for it any time.
The volume of sawnwood used annually or sold at the "Katako" market cannot be ascertained. The use of savanna species for sawn timber products is neglible in Nigeria, though in countries less endowed with timber resources it can be important. Usually, most sawnwood arrives from the Southern part of Nigeria, notably Bendel State. Some by train and some by lorry.
There are supplementary sawnwood from timber mills at Dogon Karimi in the Sanga River Forest Reserve in Kaduna State which supply species of Chlorophora excelsa, antiaris africana, Detariam senegalensis, Khaya grandi foliola, celtis zenkeri Terminalia superba, ceiba pentandraa and Khaya senegalensis.

Many of the bigger building jobs in Jos may be carried out by large firms from outside the cities and some of the local building firms. They buy sawnwood locally for use in these buildings.

Traditionally, builders and carpenters, cabinet makers and other numerous wood users use sawnwood for various purposes such as making of chairs, window and door frames. Sawnwood could also be used for the ceiling and decking of houses.

Savanna vegetation covers 85% of Nigeria. A large forest produce would be expected through improved silvicultural techniques and it is hoped that in the foreseeable future, wood production in the savanna region may increase and may even be exported to other parts of the country.

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SEED AND BUD DORMANCY

by

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INTRODUCTION

Growth in plants is not all that a continous process from germination to death. Almost all plants experience some time in their life cycle periods when growth is temporarily suspended or at least retarded to the point of not being visibly detectable. This suspension of growth can be observed in plants parts associated with either the propagation of the plant e.g. seeds or its continued development such as the buds. This suspension of growth can be caused by both external and internal factors. Thus it is this suspension of growth in plants brought about by both external and internal factors that is normally referred to as DORMANCY.

Since both the growth of seeds and buds can be suspended at one time or the other, we have two main types of dormancy, namely the seed dormancy and the bud dormancy.

SEED DORMANCY:

Germination is the forcing of the radicle through the seed coat and is normally associated with phytohormones such as Ascorbic acid and Gibberellic acid which help in the production of hydrolase which mobilizes different food reserves. This results to cell division and cell elongation. Any factor that inhibits any of these processes is likely to cause a state of dormancy in the seed. Thus seed dormancy is caused by various external and internal factors that will block its germination. Some of these factors are as follows:

INCOMPLETE EMBRYOS: In some plants like members of orchideceae, at the release of the seeds or fruits from the parent plant, the embryos have not reached a morphological maturity capable of germination. During the dormancy state these seeds get developed and can then germinate if other conditions necessary for germination are satisfied. The state of dormancy in this case is from the time of release of the seeds to the time of germination.

PRESENCE OF HARD SEED COAT: Germination is not possible without imbibition of water and gas exchange. The presence of hard seedcoat can cause dormancy by either depriving the seed of water, depriving the seed of gas exchange or by mechanically restricting the growth of the embryos.

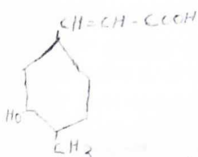
Impermeability to water and gases can be caused by barrier provided by the endosperm, the nucellus, the seed coat or the fruit walls. Some members of leguminosae have in addition an external waxy covering. If seeds are prevented from getting water, it cannot germinate because the process of the hydrophilic groups such as $-NH_2$, $-OH$, $-COOH$, attracting the dipolar water molecules to themselves, making the macrohydrates to swell, resulting to germination, will not take place.

Also if oxygen is lacking the respiratory chain which supplies energy in form of ATP for germination will not take place.

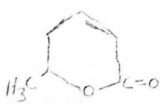
MATURATION OF DRYING/AFTER-RIPENING: In a member of species, the capacity to germinate is only attained after the seeds have passed a period of time under normal condition for germination. A prerequisite to germination for this type of seed then, is a period of after-ripening. In grains like maize, the increase in the ability to germinate run parallel to a decrease in the water content of the grains.

INHIBITORS: All parts of a seed or a fruit including the embryo itself can contain inhibitors which block germination. These substances can even kill the embryo if present in large amount. Natural germination inhibitors, however, do not reduce the viability of the seed nor produce any growth abnormalities in the seedling germination. Some of the natural inhibitors of germination that have been identified are coumarin, parasorbic acid, ammonia, phthalids, ferulic acid, dehydraacetic acid and abscisin II. Cafferic acid as well as cyanide releasing molecules are also examples of such inhibitors.

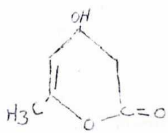
The structure of some of these inhibitors are:



Ferulic acid



Parasorbic acid



Dehydroacetic acid

OTHER ENVIRONMENTAL CONDITION:

Apart from these factors already mentioned, specific light and temperature requirements must be met by some species of seeds plants before they germinate. This type of seed dormancy caused by the above factors can be broken only by the specific temperature and light required by those plants.

BUD DORMANCY:

Lateral and terminal buds normally develop on the newly elongated shoots of temperate zone woody plants during the spring and early summer months. But before giving rise to vegetative or reproductive growth, the buds of many plant species go through a period of dormancy. This type of dormancy appears to be brought by shortening of day length in many plant species. Low soil moisture, in summer autumn can also cause dormancy in other species. Abscisic has been extracted from the leaves of some plant species like sycamore maple and found to cause bud dormancy in such species.

BREAKING OF DORMANCY:

Scarification is usually used to break dormancy of seeds. Scarification is any treatment that renders the seed coat permeable to water and/or oxygen or weakens the seed coat so that the embryo expansion is not physically retarded. Scarification can be either mechanically or chemically. Mechanical scarification involves either nicking the seed coat with knife or putting the seeds o in a bottle containing something like sand or fine stone granules. This will weaken the seed coat so that it becomes permeable to water and oxygen and at the same time allowing the embryo to expand. At times mechanical scarification can be brought by microorganisms in the soil. These organisms in the process of feeding, attack the seed coat and render them loose.

The other type of scarification is chemical scarification. This is done by the application of some chemicals that promote germination. Work on this by Doovenbos (1953) has revailed that some chemicals such as potassium nitrate (KNO_3) ethylene, Gibberellin, kinetine and thiourea $NH_2 - \overset{S}{\overset{\|}{C}} - NH_2$ if applied on the seeds can promote germination by clearing the barrier created by the growth inhibitors and other factors that bring about dormancy.

Such chemicals like chlorohydrin vapour, sodium thiocyanate, pottassium thiocyanate, thiocirea, carbon disulphide and dichloro ethylene have been used to control bud dormancy Jost (1894) and Klebs (1914) have shown that light can control the dormancy of some trees. In temperate plants, cold treatments can be used to break bud dormancy. This cold treatment can either physically or chemically destroy these growth inhibitors or can produce some abscisic acid antagonist such as Gibberellic acid which will neutralize the effect of the growth inhibitors. The use of cold treatment to break dormancy was demonstrated by Muller Thurgan (1880) using potato and also by P-fetter (1904) using woody plants.

Ecologically high temperature experience may break dormancy in situations where fire or exposure to intensive sunlight has elevated the temperature of the soil. This was discovered by Loomis and Evans ((1928).

Dormancy caused by incomplete embryo can be broken by allowing the embryo to mature within the seed in an environment favourable to germination. Also Molish (1909) developed a warm water treatment for breaking dormancy of leafless branches using water between the temperature range of 30°C to 40°C.

ECONOMIC IMPORTANCE OF DORMANCY:

Dormancy allows the seed to pass through a hard condition such as short rain fall. Seeds that can remain viable but dormant until sufficient water is available have a good chance of survival. An example of this is desert shrub quayule. It's chaff contain some inhibitors which make them remain dormant in dry season but with strong rain, the inhibitors are washed away so that the seeds will germinate. Thus the occurence of dormancy may constructively limit the time at which seeds will germinate.

It helps in the determination of location for germination. Dormancy can limit the germination of some species of plants to certain areas. Typical examples of this is cypress seed which will only germinate in sandy soil and spores of corn smut which are stimulated to germinate in the proximity of corn plants.

It also helps in adaptations of species to the seasonal characteristics of the environment either to the range or to the seasonal limits of ecological variables in the environment. Example of this is photoperiodic e imposition of bud dormancy on decidous trees which adapt them to the winter or the dry season. Also the requirement of weed seeds for mechanical scarification makes them germinate in only soils that has been disturbed.

The ability of many weed seeds to lie dormant for many years in the soil has proved a great in-convenience to farmers. During ploughing of the soil, dormancy of many of these seeds are broken, allowing them to germinate and compete with economic crops in that area. The eradication or even control of many of these seeds are impossible because dormancy of all of them cannot be broken at a time. This makes the farmer experience the same type of problem each year.

On the other hand, this helps the species of plants with seed coat impermeable to water such as that found in species of convolvulus in the arid region, to persist adverse conditions. In order for those seeds to imbibe water and germinate, they must be broken mechanically and the imbibitiono of water is gradual over a long time, thus all the seeds cannot germinate each year. No matter the adverse condition, therefore, all the species of the plants cannot be eradicated.

Another significance of dormancy is on cereal grains. The temporary dormant period experienced by many cereal grains allow for their harvest, dry, storage and ultimate use as food. Otherwise these grains will germinate in the field and be useless to man.

PROLONGING DORMANCY:

From the above discussion, we have seen that dormancy has got some merrits. Thus it is often very important to prolong rather than to shorten dormancy.

In temperate zones, the warm weather of an early spring may cause buds to open before danger from frost is past. Under such conditions, a severe frost can cause enormous damage to the plants. Also a many crops are normally stored after harvest till the next growing season. The farmer would not want the seeds to germinate under storage and in the case of tuberous seeds like yam seed, he would not want the buds to sprout out before the growing season. Under these conditions, prolonging the dormancy will be necessary.

Bud dormancy can be prolonged by spraying with certain chemical compounds. This has been successfully done over the buds of potatoe tubers. The sprouting of potatoe tubers in storage may be prevented almost completely by treatment with certain growth regulators. The methyle ester of naphthaline acetic acid is now widely used for this purpose. When shredded pepper, impregnated with some amount of this ester is scattered among potatoe tubers in a storage bin, sprouting of the buds is inhibited. The tubers remain completely dormant and sound after storage.

Also in decorative flowers around compounds, the lateral buds may not be wanted to continue growth depending onthe position it is located and on the purpose for which it is planted. Although terminal bud usually supresses the lateral bud growth at times, the terminal bud may be accidentally damaged which will then, if not checked, release the lateral buds which will then grow to vegetative branches. Certain phytohormones such as indole Acetic Acid (I.A.A.) and Gibberillic acid (G.A) when injected in the position of terminal bud will supress the lateral buds from growing.

It has also been suggested that withholding of water and mineral nutrients especially nitrogen is used to suspend growth.

CONCLUSION:

Dormancy has been recognised as a physiological process which affects the development of plants in many ways. Since this recognition, immense progress has been made by man towards an understanding of this phenomenon. He has learnt to control it by application of chemicals or by artificially manipulating the environment so that inducement or release of dormancy. can be predicted.

This understanding of dormancy has been very useful in the fields of both horticulture and Agronomy. Apart from that, many plant physiologists are still working on dormancy in plants and its control and it is hoped that the results of their works will very much help to improve crop production.

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ELECTROMAGNETIC FIELD EFFECT ON CHROMOSOME

by

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INTRODUCTION:

Chromosome aberrations and other cytological abnormalities produced by various physical and chemical agents are known. But reports on chromosome bandedness induced by electromagnetic field conditions applied to plant or animal are few. Therefore, the effects of the following three field conditions on the chromosomes of broad bean (*Vicia faba L.*) have been studied.

1. High frequency electromagnetic field (HF) produced by a.c. circuit of a tesla coil.
2. Electrostatic field (EF) produced by d.c. circuit of electrical corona.
3. Magnetic field (MF) produced by electromagnets.

RESULTS:

Dividing cells treated by either EF or MF did not show any fragmentation or banding effect on chromosomes. On the other hand chromosomes of HF treated cells in all stages of mitosis revealed aberrations predominently of one type viz., bandedness through apparent fragmentation of chromosomes. Other aberrations like stickiness, clumping, lagging bridges, etc. were rare. Gaps of achromatic lesions on chromosomes showed continuity of segments by thin feulgen-positive DNA fibres which did not permit adjacent segments to separate. Further, it is noted that dispersal of chromosomal matrix at specific sites produced the gaps and apparent fragmentation. The fragments of each chromosome were found to be in a linear alignment. The fragments and the gaps occured in pairs at identical loci on sister chromatids at metaphase giving rise to banded appearance of chromosomes. This clearly indicated that HF stimulates the replication of DNA without its concomitant division.

Since it is the electromagnetic field produced by the a.c. circuit of the tesla coil as employed in the present study that produced the apparent fragmentation and banding, all the effects must be due to the combined hyperfine effects of both varying electric and magnetic field. Although magnetic and electric field are known to have some effects on biological system it is so far not reported nor observed in the present experiment that they have any influence on endoreplication or chromosome banding. Therefore most of the effects noted presently is attributed evidently to electromagnetic field condition.

DISCUSSION:

Physical and chemical agents capable of causing chromosome aberrations do produce more than one type of aberration at the same time. It is interesting to note that HF produces only bandedness of chromosomes through their apparent fragmentation in all stages of cell division. The mechanism of gap formation in chromatids and consequent reduplication and band production on chromosome would be by the localised unfolding and despiralisation of reduplicating chromatin fibres at the interband regions. As pointed out by Commings and Riggs (1971) this could be effected by solubilisation and dispersal of DNA-binding heterochromatin-specific nucleosteric proteins which are normally responsible for the folding, spiralisation and condensation of chromatin fibres (at mitosis and meiosis) from the microenvironment around the interband regions by the HF directly or indirectly by the concentrated stimulation of DNA dependent histone inactivating enzymes.

The manner in which the selective solubilisation of DNA binding proteins at specific regions of chromosomal matrix might lead to bandedness of chromosome is understandable. It is also reasonable to assume that the electromagnetic fields of the particular frequency used in the present experiment could effect changes in specific charged proteins in certain regions of chromosome matrix (nucleoprotein complex) ultimately giving rise to banded appearance.

CONCLUSION:

It is proposed that HF is characteristicaly a chromosome band inducing agent and the process of band formation might involve the dispersal of a kind of protein which is concerned with the coiling, folding and condensation of DNA fibres from the interband regions of chromosome by the action of HF directly or by the stimulation of histone inactivating enzyme.

SUMMARY:

High frequency electromagnetic field (HF) has been observed to cause endoreplication of genetic material and consequent bandedness of chromosomes of Vicia faba. Whether electric or magnetic field condition is specifically responsible for the endoreplication and banding effect has been verified. Neither of these alone has been found to be effective as the combined hyperfine effect of both varying electric and magnetic field of the HF. The mechanism of band production by HF is interpreted as reduplication DNA fibre in chromosome accompanied by localised unfolding and despiralisation of its supercoils consequent on the selective dispersal of DNA-binding nucleosteric proteins from the microenvironment around the interband regions directly by the electromagnetic effect or indirectly through the stimulation of a DNA-dependent histone inactivating enzyme.

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BIOLOGICAL CONTROL OF PLANT PATHOGENS

by

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1 INTRODUCTION

(A) DEFINITION OF PLANT PATHOGEN

A plant pathogen is any living agency which incites a disease in plants. A pathogen is not the sole cause of a disease since several other factors combine or work together with the pathogen to result in a disease. It is only a part of what Walker (1969) referred to as CASUAL COMPLEX. Disease-inciting agencies in plants can be broadly categorised into five thus: fungi, bacteria, viruses, actinomycetes and nematodes. These can be either parasites and/or saprophytes.

(B) BIOLOGICAL CONTROL

Garret (1970) reasoned that the control of plant pathogens by biological means referred to any condition under which or practice whereby, survival or activity of a pathogen is reduced through the agency of any other living organism (except man himself) so that there will be a reduction in frequency of occurrence of the pathogen. Biological control involves the use of living organism for the elimination of a pathogen or its pathogenic effects. According to Debach (1974), biological control is only a part of the broader over-all phenomenon of natural control. This type of control can take three forms (Rishbeth 1972).

i Antagonists may be introduced to prevent establishment of the pathogen on the host plant, e.g. when wounded roots of tomato seedlings were exposed to *Cephalosporium* sp (fungus) the xylem vessels become invaded and obstructed and the ability of the fungus *Fusarium oxysporum* .f. *lycopersici* to spread in the tissue after subsequent inoculations was limited (Philips et al; 1967).

ii Alternatively, the pathogen may be affected by production of antibiotics. Coating the maize Kernels with *Bacillus subtilis* markedly controlled the incidence of seedling blight caused by *Fusarium roseum*. (Chang and Kommedael, 1968)

iii Incorporation of amendments into the soil promotes competition and even antibiosis between the microorganisms and the pathogen leading to the latter's death. As a specific example, *F. solani*. F. *phaseoli* causing bean root rot disease has been reduced by the addition of organic amendments to the soil. Garrett (1944) proved that by planting legumes in association with barley, the incidence of the take-all disease of the crop caused by Ophiobolus graminis will be reduced. He noted that legumes take from soil more nitrogen than they excrete into the soil eventually causing its shortage and hence an advance effect on the pathogen.

(C) ANTAGONISM AND ITS MECHANISM

Antagonism as defined by Wood and Tveit (1955) is any activity of one organism which in some way adversely affects another organism growing in association with it. The effect of antagonists on pathogens is a continuum ranging from stimulation, through no inhibition to inhibition of one or several pathogens (Broadbent, Baker and Yvonne, Waterworth, 1971). Also, Akueshi (1978) believed that the antagonism of one organism on a plant pathogen is based on competition antibiosis and exploitation.

Further work by Brashier (1978) shows that there are two major roles an antagonist could play in biological control:- These are

i That of overtaking and replacing the pathogen during its active colonisation of host tissues.

ii That of replacing a static pathogen in older established lesions.

In the former role, the antagonist could contribute to general pathogen suppression, e.g. antagonistic effects of Trichoderma sp on Phytophthora sp which causes rots of certain plant. Wood and Tveit (1955) and Debach (1974) realised that a candidate antagonist must (a) be extremely aggressive

(b) have high reproductive capacity

(c) have a high degree of host specificity

(d) be persistent under unfavourable environmental and nutritional conditions, as well as good adaptation to and tolerance of broad range of environmental conditions as the pathogen.

(e) be in active state as well as be present in great numbers.

The limitations of antagonism can also be briefly focused on, Since food and other substrates are usually in short supply there is great competition among soil microorganisms for the available substrate. The soil environment is also rendered inhospitable to continued growth of microorganisms by the accumulation of inimical metabolic bye-products, (Patrick and Toussoun, 1970).

(D) HISTORY OF BIOLOGICAL CONTROL:

The application of chemicals or other physical means to control plant pathogens has been known to have non-negligible shortcomings. According to Snyder, Wallis and Smith (1976) all these treatments affect the entire biophase of the soil rather than just the plant pathogens, and re-invasion by both desirable and undesirable microorganisms occur quickly. A detailed review that showed that biological control can solve these problems has recently been published by Baker and Cook in 1974. Smith (1941) had earlier warned of insects potential to develop resistance to insecticides. Biological control has been traced back to entomology (Garrett, 1964) in early days when the Chinese used Pharaob's and Monomorim Pharaonis (L) by introducing the nests of these ants into barns in order to combat some insects noted for spoiling stored products. Before 1959, the giant toad Bufo marinus (L). was introduced from Cayenne (Northern South America) into sugar cane farms to control white grubs. It was soon introduced to Barbados, Jamaica and other areas (Simmonds et al 1976). An ant Formica omnivora was introduced from Cuba to Jamaica to control "insects and vermin" in 1972. In 1908, Potter demonstrated that the activity of a plant pathogen could be inhibited by an accumulation of its own metabolic products. More interest in biological control in recent times was necessitated by the success achieved when redalia beetle Rodolia cardinalis was introduced to wipe out cotton cushion scale Icerya purchasi that threatened the young citrus industries in California in late 19th centruty. Millard and Taylor (1927) reported the control of scab in potatoes grown in sterilized soil and inoculated with streptomyces scabies through simultaneous inoculation of the soil with S. praecox - a saprophyte. A huge success was also achieved by Safferman and Morris (1964) on the control of "algal blooms" in sewage by using virus Lpp-1. There are several attempts being made on the biological control in recent years. This increased from 28 attempts to 57 between 1920 to 1940 (Debach 1963). The properties that make biological control more popular than chemical (which is most commonly practised) control are tabulated below; (Debach 1974).

CATEGORY	BIOLOGICAL CONTROL	CHEMICAL CONTROL
1 Environmental Pollution	None	Common
2 Danger to Man, Wild-Life Other non-target organisms soil, etc.	"	"
3 Upsets in Natural Balance and other ecological disruptions	"	"
4 Permanency of control	Permanent	Temporary-Must Repeat one to many times.
5 Development of Resistance by the Pathogen	Extremely Rare	Common

(after Debach, 1974)

2. PRACTICAL EXAMPLES

(A) BACTERIA

(i) WITH BACTERIAL ANTAGONIST

Keane, Kerr and New (1970) Kerr (1972), had proved that Agrobacterium radiobacter was effective in controlling crown-gall disease caused by Agrobacterium tumefaciens. Recent greenhouse experiment by Dhanvantari (1976) on peach plant confirmed this. He found that 162 days after infestation with A. tumefaciens, gall development among plants treated with the pathogen only was 46%. In contrast, only 7% of the plants treated with antagonists prior to inoculation with the pathogen developed galls.

TABLE 2:

Protection of peach seedlings by A. radiobacter var. radiobacter isolate 84 from crown-gall infection in a green-house experiment.

TREATMENT	NO OF PLANTS	% GALLED
A. tumefaciens isolate p411C	60	46
A. tumefaciens " "	100	7
+ A. radiobacter var.		

x^2 for heterogeneity between treatments - 34.98 df - 1; p 0.001 (after Dhanvantari, 1976). Larry Moore (1977) also elaborated more on the control of crown-gall disease, but this time, on Prunus roots and arrived at the same conclusion.

Pseudomonas tolaasi is the casual agent of the brown blotch disease of cultivated mushroom. Nair and Fahy (1972) isolated P. tolaasi from casing peat of healthy and diseased mushroom beds, compost of diseased mushroom beds and from soils around a mushroom farm. The three antagonistic bacteria employed in its biological control were non-fluorescent Pseudomonas sp. (closest to P. multivorans) from soil; strains P. fluorescence and Enterobacter aerogenes from peat. The pathogen was effectively controlled.

(ii) WITH VIRAL ANTAGONIST

Very few works have been done in this type of antagonism. However, Boyd et al (1971) reported that the crown-galls produced on tomato plants were smaller if an Agrobacterium tumefaciens bacteriophage was present in the plant. This control measure was effectively only when the phage particles were absorbed 12 hours prior to bacterial inoculation.

(B) ACTINOMYCETES

Actinomycetes are a group of gram - positive bacteria with a a capacity for mycelial growth. (Linton, Berkely, Madelin and Round 1972). Their affinity towards bacterial life can be attributed to their procaryotic cellular organisation, the chemistry of their cell walls, their nitrogenous metabolism and their sensitivity to antibiotics and actinophages. Their fundamental characteristic is the production of very fine mycelium.

Works done on the biological control of pathogenic actimomycetes have been regrettably scanty. The most important being the experiment on the potato scab disease. The potato scab pathogen, Streptomyces scabies is the most studied parasitic actinomycetes. Simultaneous addition of both green manure and a saprohytic, vigorously growing antagonistic acitinomycete Streptomyces praecox to the soil gave a substantial control of the pathogen (Millard and Taylor, 1927; Wood and Tveit, 1955). The explanation of this is that since potato scab disease is prevalent where nutrient content is low in the soil, addition of green manure will retard the growth of the casual agent. By incorporating manure, some saprophytic and parasitic actinomycetes are released into the soil, so that obligate saprophytes become dominant, hence the elimination of the parasite (pathogen) (Wood and Tveit 1955).

(C) FUNGI

(i) WITH BACTERIAL ANTAGONIST

A popular example of this type of antagonism is shown by the action of Bacillus subtilis on Fusarium roseum F. dianthi notorious for being a casual organism of the stem rot of carnations. The antagonist controlled the pathogen when the affected cuttings are dipped into a suspension of the former (containing 3 x 10^8 cells/ml). Baker and Aldrich (1970) got the following tabulated results after the experiment.

TABLE 3: CO Control of Fusarium stem rot by dipping cuttings into a Suspension of Bacillus subtilis ($3x10^8$ cells/ml.)

Treatments	% Cuttings with Symptoms[a]
Inoculated, dipped in cell suspension	16.7
Non-inoculated " " " "	0.0
Inoculated dipped control	54.2
Inoculated, control	

[a]Numbers are percentages of cuttings with symptoms of out of a total of 48.

Cuttings were inoculated by adding 10 propagules of F. roseum f. sp. cerealis per ml. of Perlite rooting medium. (after Baker and Aldrich, 1970).

(ii) WITH ANTAGONISTS IN SOIL AMENDMENTS

Some fungi that cause the root disease of plant are able to survive in the soil without their hosts, by living as saprophytes on soil organic matter (Garrett, 1936). This results in an increment in the activity of soil microflora e.g. the take-all disease of wheat (Fellows 1929). Garret (1938) discovered that a decline in the viability of the resting mycelium of Ophiobolus sp. in infected wheat straw can be caused primarily through natural decomposition by other soil microorganisms. Ophiobolus graminis is the casual organism for the take-all disease of cereals. The soil organic matter added was particularly devoid of nitrogen so that microorganisms will break down resting mycelium of Ophiobolus as a source of nitrogen, thus killing it (Garrett, 1940). Various workers at different periods, e.g. Heck (1929), Jansen (1932) and Norman (1933) have confirmed the decomposition of dried and powdered fungus mycelium by the soil microflora.

WITH FUNGAL ANTAGONIST

Fungal antagonism on fungi, which seems to be the most studied is referred to as hyperparasitism of fungi or mycoparasitism. The damping-off disease of bean caused by Rhizoctonia solani can be controlled by the application of Trichoderma harzianum in the form of wheat bran culture (Hadar, Chet and Henis, 1979). The lytic enzyme, B - (1-3) glucanase produced by the antagonist can degrade the cell wall of Rhizoctonia thus killing it.

Trichoderma viride has also been known to control R. solani by the production of GLIOTOXIN. As the name suggests, gliotoxin is very poisonous and disturbs the metabolic processes of the pathogen. Inability of the pathogen to overcome the adverse effect of the toxin on it consequently leads to its extinction.

Also, Umeokafor (1978) successfully demonstrated the control of Fomes annosus affecting loblolly pine seedlings by using a special isolate of Trichoderma viride.

Ergot, the casual organism of which is Claviceps sp. can be controlled by applying a clone or Fusarium roseum 'Sambucinum' (Mower, Snyder and Hancock, 1975). Fungal root pathogens of tomato plant, e.g. Sclerotium rolfsii, Rhizoctonia solani, Pythium deliense and Fusarium solani have been controlled by interacting them each with Trichoderma harzianum, Co-inoculation of T. harzianum with these tomato pathogens both in slide cultures and in Agar

Using avirulent strains of viruses to control virulent ones is the only direct method of wiping out the latter type of viruses. This type of interaction is referred as Cross-protection, antagonism or interference (Fletcher, 1978). Virulent strains of Cacao virus 1A can be controlled by applying mild strains of the same virus. Vectors of the viruses can be eliminated. For example birds can be used to devour aphids carrying the Yello Dwarf irus (DV) (Walker, 1969). Birds can also remove eriophyid mite known to transmit Ryegrass Mosaic Virus (RMV) and Agropyron mosaic Virus (AgMV) (Chamberlain 1975).

SUMMARY AND DISCUSSION

Antagonism is a major factor in the biological control of plant pathogens. This is clearly evident in the use of one type of organism against the same type e.g. fungus antagonising pathogenic fungus; or the use of one type of organism against another type e.g. bacterium antagonising fungus.

In most, if not all, cases biological control succeeds only when the antagonist is inoculated simultaneously with or slightly before the pathogen is inoculated. By this action, the antagonist must have multiplied rapidly, this being one of its characteristics, and is then able to act either through exploitation, competition or antibiosis on the pathogen (Akueshi 1978). Addition of organic amendments to the soil is essential in increasing the population of soil saprophytes which are able to suppres the pathogen mostly through competition and antibiosis (Mehrotra and Caludius 1972) and also through change in the p^H of the soil with the resultant effects in microbial population, and on toxicity of chemicals produced in the soil during decomposition of residues, change in water-holding capacity of the soil, injury to plant roots thus resulting in increased or decreased susceptibility to the pathogen; or inhibition or depression of sporulation by the pathogen (Zentmyer 1967). Notable among all barley and Sorghum straws control root rot pathogens effectively due to their high C:N ratio that favours growth of competitive microbes (Ghaffer, Zentmyer and Ervin, 1969 and Akueshi 1975). Of all the classes of pathogens, Viruses nematodes and actinomycetes received the least attention of biological control workers. Viruses created the most difficult problems in that they cannot be propagated on artificial media and cannot easily be examined at least with the light microscope. Above all, viruses are known to resemble host nucleoproteins and thus "live a borrowed life" completely depending on the host metabolism (Bos 1976). An ideal contro agent both inhibits the host's propagative system as well as eradicates its completely. However, Lewis and Papavizas (1975) ruled that fungistasis, lysis coupled with antagonism and antibiosis together with production of volatile substances and and toxicants (associated with decomposition of amendments) determine medium showed that its hyphae twined around and strangled the hyphae of the test pathogens (Akueshi, 1975). Fusarium solani and Sclerotium rolfsii cause the wilt of tomato while Pythium deliense and Rhizoctonia solani cause the damping-off diseases of the same plant.

Fedorinchik (1971) showed that T. lignorum was antagonistic Hypocrea rufa and Verticillium dahliae both affecting cucumber.

OTHERS

Mehrutra and Caludius (1972) made a headway by successfully controlling the growth and subsequently eradicating Fusarium oxysporum that causes wilt diseases of Lens culinaris through the inoculation of Streptomyces gougeuoti into the infested areas of the plant.

Decrease in pathogenicity of Ophiobolus graminis has been noticed on inoculating it with certain virulent viral strains. (Lemaine et al 1970).

Using predacious insects to control pathogenic fungi has not been an encouraging venture, due to the amount of labour involved and the strict supervision of the control period but some members of Diptera and Coleoptera can reduce the inoculum of smuts, rusts and mildews.

(D) NEMATODES AND VIRUSES (GENERAL)

Nematodes which are usually soil borne cause wilting and stunting of the plant stems. Those with large open stoma e.g. Mononchus, and Anatonchus and those with stylets e.g. Discolacinus and Seinura make good antagonists. Boosalis and Mankau (1965) observed the feeding of Thornia sp (a nematode) on another nematode Tylenchus sp larvae affecting citrus.

There are 4 main ways through which fungi can be nematophagous:-

(i) Adhesive net works in Arthrobothrys oligospora Fres. Here the hyphae grow into an anastomosing network of sticky surfaces into which nematodes move.

(ii) Sticky, short lateral branches typical of Dactylella lobata Duddington.

(iii) Knobs of Monacrosporium ellipsosporum Grove

(iv) Constricting rings e.g. in Dactylaria bembicoides Drech.

Most nematode-trapping fungi are in the orders Zoopagales and Moniliales (Duddington 1956). Nearly all works on biological control of nematodes are discouraging. In short there are no immediate or long term prospects of using biological agents against nematodes (Jones 1972).

the pathogen's survival or destruction. The impact of several root diseases can be reduced by altering the root environment to confer a competitive advantage on saprophytes as a means of biological control. (Umeokafor, 1978).

Wood and Tveit (1955) asserted that no great success has attended the use of antagonists in the control of plant pathogens up to the present. This method of control is not likely to compete with ordinary fungicides or bactericides except in isolated cases under special conditions. However, the use of saprophytes to influence the establishment of pathogen has a brighter future especially if other methods are difficult and expensive. Usually, it is the judicious and well-informed use of crop rotation, sanita sanitation, resistant host varieties, chemotherapy, physical treatments and biological agents that can successfully control plant pathogens (Jones 1972; Crolland Matthews (1977). Apart from being energy-sapping uneconomical on a wide scale, biological control of plant pathogens is also impracticable in most cases.

Even though this method of control may not be able to compete with the use of chemicals because of the strict supervision and time involved, it must be understood that intensive research, aimed at finding lasting solutions to its limitations can, in the end, increase human awareness for it.

We hope that with the performance of intensive researches coupled with careful coordination of phases in different world countries there will be international biological control. The setting up of two organisations namely Commonwealth Institute of Biological Control nd International Organization for Biological Control (IOBC) is an indication of a brighter future for biological control (Simmonds et al 1976).

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MAIZE CULTIVATION AND ITS ECONOMIC IMPORTANCE

by

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University of Jos.

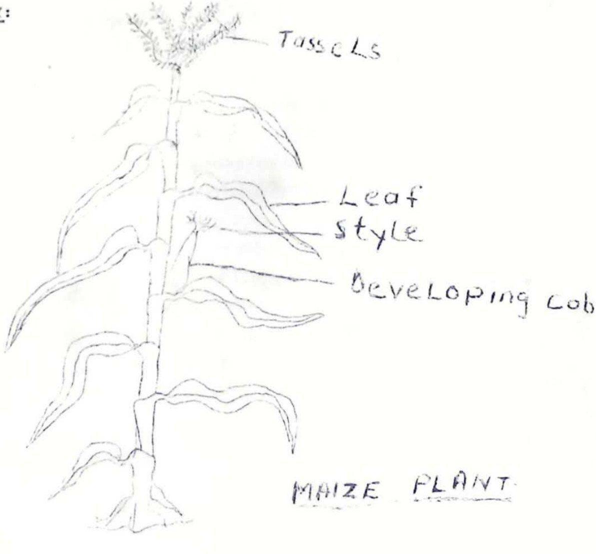
INTRODUCTION:

Maize (zea mays) is one of the most important cereals in the world - it is also the most widely distributed. Most of the maize crops are used in the countries in which they are grown and only about 10 percent enters into world trade of which the United States supplies about 60 percent. In Nigeria, it is consumed locally.

ORIGIN:

The name is derived from an Arawak - Carib word 'mahiz'. It is also known as 'Indian Corn', and in America simply as 'Corn'. Maize was first grown in Mexico 4,500 years ago. It was brought to Europe by Columbus and was introduced into Africa by the Portuguese in the 16th Century. It is now found all over the world and although its natural habitat is the tropics, most of it is now produced in the warmer parts of the temperate regions - in the corn belt of the U.S.A. the Steppes of Southern U.S.S.R. and the sub-tropical regions of South Africa and Argentina.

MORPHOLOGY:



MAIZE PLANT

Maize belongs to the grass family 'Gramineae'. It is an annual crop which is grown from seed, and may reach a height of 4.5m. The stem is solid and usually does not produce branches. The male and female flowers are carried in separate clusters on the same plant. The male flowers called the 'tassels' grow near the top of the plant,, and are long and feathery. When they are ripe, they release pollens. These fall on to the female flowers, which grow lower down the stem on a long, thick structure called cob. When the female flower receives the pollen, fertilization occurs and the cob begins to develop and ripen. The grain are set in rows round the cob and the cob is enclosed in a covering known as the husk.

VARIETIES:

There are many varieties of maize. It is heterogenous, complex species, in which all forms hybridize freely. Cultivars can be divided into groups according to the structure of the grain, which is usually dependent upon one or few genetical characters. In the 'dent' types there is a depression in the grain, which is caused by shrinkage. 'Flint' types have very hard grains, 'Flour' types have soft grains. 'Pop' corn has small grains which expand and burst when they are heated. 'Sweet Corn' has very sugary taste. Dent maize is the most widely grown and produces very high yields. Flint maize is common in Asia, Africa and South America. Flint maize ripens earlier and suffers less damage from insects when it is stored. Both flint and dent maize have white and coloured varieties. The coloured varieties contain more carotene, from which the human body can produce vitamin 'A'.

METHOD OF CULTIVATION:

Maize cannot withstand frost during the growing season, and so it is essentially a crop of warm climates. It needs an annual rainfall of between 760 and 1500mm. Excessively high rainfall (2500mm) is harmful to its growth. Maize prefers deep and well-drained loamy soils which are rich in organic matter and are well supplied with water and nutrients. It grows poorly on light sandy soils and in waterlogged conditions. In Africa maize is often the first crop which is cultivated when the land is freshly cleared from bush. After the soil is cleared, the seed is placed in the loose and friable (easily crumbled) soil that has developed under the bush. If maize is being sown in land which has not recently been cleared from bush, then the soil should be dug deeply and worked with hoe to make it friable. In mechanical farming, deep ploughing to about 20 cm is carried out to displace the roots of the previous vegetation and to bury any stubble or plant remains. The land may then be narrowed and ridged before planting.

Maize is planted dried in the field either on the flat or ridges. Planting may be done on ridges or mounds which have been created to conserve moisture to help drainage and to concentrate fertility round the plant.

Sowing may be done by hand or mechanically. An average spacing of 1M by 1M to 2.8CM by 2.8CM between ridges or plants is quite common. The depth for planting the seed varies between 2.5 and 10 CM depending on the type of soil and the climate. Two or more seeds are placed at one planting position, and these are thinned to one seedling each when the crop comes up. In subsistence farming in Africa, 3 or more seeds may be sown at one position. These are not thinned.

Maize makes very high demands on the nutrient supply of the soil. For this reason it is often the first crop which is grown in a system of crop rotation. It will produce extremely high yields if fertilizers are applied. Organic manure, such as farm-yard manure produce better results than inorganic manures. The crop responds very well to either mixed or Nitrogenous fertilizers. Maize cannot stand competition from weeds. Early weeding is important and should not be delayed beyond the fourth week after sowing, because weeds become established very easily when the crop is in the early stages of its growth. The range of time from sowing to grain maturity varies widely in modern cultivation from 90 - 190 days and is influenced by both day-length and temperature. Maize flowers earlier in short warm days than - longer cooler days, i.e. they are short day plants. This explins why maize can grow in such a wide range of environment.

As the crops is ripening there are two distinct stages in the texture of the grain:-

(1) the 'milk' stage, when the cob contains about 70% moisture and the grains are tender;

(2) the 'glazed' stage, when the crop is fully ripe and the grain contains about 20-25% moisture. Most of the crop is harvested when it is at the glazed stage. Farmers harvest the crop either by picking only the cob and leaving the husk on the plant, or by picking the cob, with the husk still on it, and removing the husk after a period of storage. This later method is useful for two reasons; the grain stores better in the husk; and the husk protects the grain from attack by post.

Yields vary from about 11250Kg per hectare to as low as 675Kg per hectare, depending on the variety of the maize, the soil and the standard of farming. Low crop yields may be caused by late planting, poor weeding, and inadequate soil.

For storing in bulk the grains are removed from the cob, dried, and then put in brick or metal silos. The traditional method is to leave the grains on the cob and to store it in wooden barn raised from the ground or on raised platform of sticks.

ECONOMIC IMPORTANCE:

Maize is used for three purposes:

- as a staple human food, particularly in the tropics.
- as feed for livestock, particularly in temperate and advanced countries providing over two-thirds of the total trade in feed grains.
- as a raw material for many industrial products. It also has a number of subsidiary uses.

The early American Civilization were based on maize, which made settled life possible in Mexico and Central America. Tortillars, Unleavened pan-cake like cornbread, were prepared from maize, and provided the unvarying staple food. It was also made into tamales and gruel flavoured with honey and capsicum. With the discovery of America, maize spread widely through out the old world. In parts of Africa suitable for its growth it replaced traditional starchy foodstuffs. Such as sorghum and millets particularly in South Africa and West Africa. It also become important when foodstuffs had to be transported to feed labout and populations which were not self-sufficient. This was possible because of the following reasons:

1. It gives one of the highest yields per manhour of labour spent on it.
2. It provides nutrients in a compact form.
3. It is easily transportable.
4. The husks give protection against birds and rain.
5. It is easy to harvest and hull, and does not shatter.
6. It stores well if properly dried.
7. It can be harvested over a long period first as immature cobs, and can be left standing in the field at maturity before harvesting.
8. Cultivars with different maturing periods are available.
9. Consumer preference, as many people prefer maize to their indigenous cereals.

Maize is prepared and consumed in a multitude of ways:

(i) It is usually ground and pounded and the meal may be boiled, baked, or fried.

(ii) The whole grain may be boiled or roasted and it may be fermented.

(iii) Maize meal is cooked with water to provide a thick mush or dough.

(iv) It may be cooked to a thinner consistency to provide gruel, porridge or soup.

(v) Cornbread is made by mixing the meal with wheat flour.

(vi) Immature cobs, preferably sweet corn, are boiled and eaten as corn on the cob, other grains may be removed and eaten as a vegetable, or it may be canned.

(vii) More mature cobs are roasted.

(viii) Cornflakes, used as a breakfast cereal are made by rolling grits after they have been flavoured.

(ix) Popcorn is made by heating the small grains, which explode or pop turning themselves inside out to produce more fluffy. white balls.

(x) It is used in making hominy and chicha, (pap)

Maize grain is an outstanding feed for livestock, high in energy, low in fibre and easily digestible. It is used mainly for this purpose in advanced countries. Its foremost use is for pig but it is also used for cattle, sheep and poultry. It is an important forage crop, being green, or dried for fodder or made into silage. If the ears are removed it is called stover.

Maize produces a number of important industrial products. (i) The main product is starch, which, when dried can be used as such or converted into dextrins. If not dried, it can be processed into syrup or sugars.
(ii) Oil, obtained from the germ, is made into soap or glycerine, but can be refined to produce a cooking or salad oil. (iii) The residues from the production of starch or oil together with the hull, are used in animal feeds. (iv) The starch may be used as human food or made into sizing, laundry starch, Urethane, plastics, and other products. (v) Maize is fermented and distilled to provide industrial products such as ethyl, butyl or propyl alcohol, acetaldehyde, acetone, glycerol and acetic, citric and lactic acids.
(vi) The protein in maize called zein is used to produce synthetic fibres of good tensile strength, and as a substitute for shellac.
(vii) The fibre in the stems has been used for making paper, and the pith for explosives and light packing material. (vii) The dry stems may be used as bedding for livestock. (ix) The cobs are used for fuel, smoking pork product, pipes, and are a source for charcoal and furfural. (x) The leaves may be plaited into mats.

From the above discussion it could be noted that maize (zea mays) plays good and beneficial roles, as human food, animal feeds, and as industrial raw material for the production of human needs. Therefore, modern methods of cultivation should be used in order to improve on the cultivation of maize. Good and resistant varieties should be cultivated in order to increase the yield of maize.

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CASSAVA BACTERIAL BLIGHT IN NIGERIA

by

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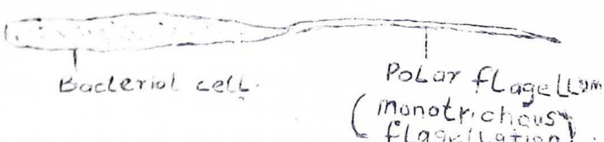
INTRODUCTION

Cassava (Manihot esculenta Crants) is an important staple food in Nigeria. The root of most varieties is palatable for human consumption, and fresh or dried roots, as well as leaves are used as forage for animals. The crop has been grown in diverse environmental conditions with minimal cultural managements and under improverished soils by subsistent farmers.

Thus, it has been estimated that the crop occupied about 1 Million hecters of land, of which only about 10 million tons are produced annually (FAO 1975). The production per capital by 1974 was only 163.35Kg putting the country 16th in the world annual production per capital (FAO 1975).

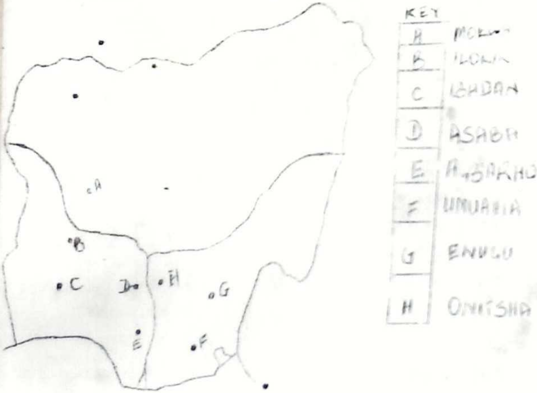
All efforts to multiply high yielding cultivars of cassava have been seriously hampered by the susceptibility of these clones to a b bacterial blight disease. The pathogen Xanthomonas manihotis (Arthaud-Barthet) starr, is gram-negative, motile, slender rod-shaped with a simple polar flagellum (fig I)



It is aerobic, fast-growing, and forms no pigments on carbohydrate-containing media.

The pathogen causes extensive damage to the leaves, petioles and stems, often resulting in complete destruction of the plant. In recent years, cassava bacterial blight (CBB) has been regarded as the most destructive disease of cassava where a total crop loss in susceptible variety is not an oddity (Arene 1974, NRCRI Ann reports 1972-76). By 1973 yield losses in the affected areas of the Eastern States of Nigeria were estimated at about 75% (Ezeilo, 1976) with cash loss of about ₦23,000,000 (IITA/IDRC, 1976).

GEOGRAPHICAL DISTRIBUTION



A MAP OF NIGERIA SHOWING THE DISTRIBUTION OF CBB IN NIGERIA

The first confirmed report of CBB in Nigeria was in 1972 (Williams et al 1973) and the distribution is shown in Fig. II.

CBB occurs in most cassava states, but is reportedly most damaging in Eastern States of Nigeria (Ezeilo 1977). The disease has been most severe on the improved varieties 60444 and 60447, which were released by the Ministry of Agriculture in 1967, although it also occurs on some local farmers varieties.

In the Umuahia area of Imo States, Presley observed the disease in many varieties at the Agricultural research station at Umudike, and in field plots established for extension purposes with cuttings taken from the station. It was not seen on cassava growing as a mixed crop on some peasant farms examined in the same area.

From Enugu to Asaba, North of Umuahia, in the forest/savanna transition zone, CBB was more prevalent than in the Umuahia region, occurring on Otuocha Agricultural station, and on local small farms.

In Bendel state, the improved cultivars 53101, 60444, and 60447 at Agbarho Agricultural station near Warri were severely affected by CBB in 1973 and 1974 (Heys 1977). However, the incidence and severity of the disease have fallen drastically over the past years. There is presently little disease at the station, even in susceptible cultivars such as 60447.

In the Western States, CBB occurs on Agricultural Research Stations at Ibadan and on some farms locally. Moving north from Ibadan, it occurs infrequently on local small holdings between Ilorin and Mokwa, and ntroduced, improved varieties at Mokwa Agricultural Station.

The incidence of CBB in Nigeria is higher on government farms and experiment stations, where varieties released since 1960 for high yield and Mosaic tolerance are grown, than on peasant farms (Presley et al 1976).

Transmission, Symptoms and Diagnosis CBB caused by the pathogen xanthomonas manihotis is transmitted by:

(i) Use of bacteria-contaminated cuttings (Lozano et al 1974).

(ii) Rain Splashes

(iii) Insects such as bees are known as vectors LEU (1972).

The pathogen penetrates the host through slomata, lenticels and wounds whence it invades and destroys the mesophyll gaining entry into the vascular tissues of the leaves and stems. This induces the characteristic symptoms of CBB which are:

(1) angular, "water-soaked" leaf spots that are initially small but later enlarge coalesce, and eventually turn brown; the affected leave become blighted and eventually abscise Fig III.

(2) Degrees of leaf wilting ranging from one wilted lamina lobe to many whole leaves.

(3) Yellow-orange gum exudation on the leaf petiole and young shoots.

(4) Severe defoliation

(5) Tip dieback resulting from vascular necrosis and death of the growing points.

All of these symptoms except angular leaf spots may be caused by other diseases or adverse conditions and therefore are not specific for CBB. Thier occurrence in the absence of the characteristic water-soaked angular leaf spots should never be the basis for diagnosing the disease as CBB.

Because angular leaf spots are the most definite diagnotic feature of CBB, the following relevant observations may aid accurate diagnosis. The bacterium normally penetrate the host via stomatal openings or through epidermal wounds (1 Lozano and Sequeira 1974), and initial symptoms appear as water-soaked angular spots that often exude yellowish sticky droplets mostly on the lower leaf surface and along veins (Fig. IV). These droplets may dry to form tiny pellets (Terry 1974, Fig IV). The spots eventually turn brown, enlarge and coalesce forming large necrotic areas. These affected areas later turn purplish-brown. When one or more lobes or the entire leaf lamina become necrotic as a result of this disease, the manifestation is called a "blight".

CONTROL

CBB has devastated large fields of cassava in Nigeria and other parts of the world. In view of its wide distribution and the socio-economic problems that will occur if it is not checked, it is important that steps be taken to control the disease. The following cultural and chemical methods have been recommended for the general control of cassava bacterial blight.

1. PRUNING OF INFECTED PARTS

Pruning of infected parts of the plant may be used to reduce the inoculum and spread of the disease. This has little effect on severely infected susceptible cultivars as new shoots rapidly become infected and so will require regular and extensive pruning.. But extensive pruning affect the efficiency of the plant and demands lot of labour time and money.

2. BURNING OF INFECTED CROPS

Parts (1974) recommended that farmers should harvest all infected crops and burn the sticks. This harsh measure cannot easily be accepted by the farmers unless assured of the source of new planting material.

3. PRACTICE OF CROP ROTATION

Terry (1974) demonstrated that dry exudates which may weigh between 9-70mg and measure 0.2-0.7mm in diameter contained about 1.5x10[?] viable cells of the pathogen. The exudate serve as means of secondary spread of the disease when they are carried by rain splashes from one crop to another. However it has been shown also that the pathogen persists for relatively short time in the soil (IITA/IDRC, 1976) and hence crop rotation of at least 6 months with deep ploughing before next planting may be enough to eradicate the pathogen from the soil.

Fig [illegible] Left — [illegible] exudation on the [illegible]; right — exudate on lower leaf surface

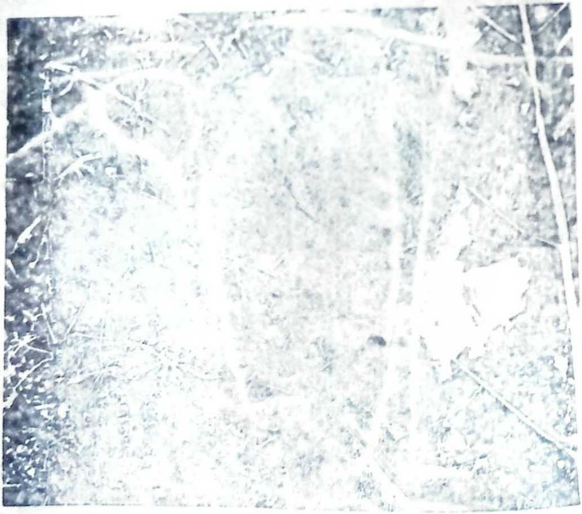


Fig [illegible]. Left — tip dieback and growth of new shoots on [illegible] part of stem; right — pellets on lower leaf surface

4. USE OF INTERCROPS AND SHADING

Arene (1975 and 1976) have shown that shading and intercropping cassava with maize, melon or their combinations reduce the incidence of the disease.

Intercropping besides other ecoromic advantages, reduces the incidence by reducing the impact of rain drops on soil and providing side shield against rain splashes carrying inoculum on the crop (Okigbo, 1977).

5. TIME OF PLANTING

It has been demonstrated independently at NRCRI and IITA that the incidence of the disease followed closely rainfall cr trend (NRCRI 1972, IITA 1972 Terry 1976). The incidence of the disease was highest during months of heavy rains and dropped off as the rains lessened. On this basis, time of planting was recommended as means of control (Farts, 1974). Up till now, good control has been achieved by planting early before the heavy rains or later towards the end of heavy rains.

6. USE OF NPK-FERTILIZER

In recent work done at Umudike it was shown that the disease severity and incidence was reduced by NPK fertilization and that K was the main contributory factor (Odurukwe and Arene, 1977). Use of fertilizer tailored to the needs of individual soils for the control of the disease is still emphasized.

7. USE OF RESISTANT CULTIVARS

This was first suggested by Goncalves (1939), and several field resistant cultivars from Brazil have been reported (Carneiro 1940) Goncalves 1948).

Extensive hybridization of selected parents has been made with the resistant clones and large numbers of progenies of the crosses have been tested for resistance in the field over the past 5 years by the Root and tuber improvement programme of IITA. Many clones and families have proved to be consistently highly resistant to the disease in a wide range of environments covering many different ecological areas of Nigeria.

8. USE OF AGRIMYCIN 500 CHEMICAL

While advances have been s made in selecting cassava varieties that are tolerant to the disease, attempts are also being made to develop economically feasible chemical control co augument the present cultival methods.

In 1977, Arene experimented the use of Agrimycin 500, a formulation of antibiotics and fungicide in the field control of CBB. The results showed that Agrimycin 500 effectively reduced the incidence and severity of the disease. The highest reduction of CBB was achieved by foliar application of Agrimycin 500 at the rate of 80gm/100 litres of water. Above this concentration the chemical showed phytotoxicity to the leaves (Arene, 1977).

CONCLUSION:

. The bacterial blight of cassava has increased in severity in the country during the past years. The use of resistant cultivars remains the most promising method of control of the disease. But, in relation to introduction and promotion of new varieties, it is important to known the areas of high, medium and low damage caused by CBB. In addition, it is important to determine the epidemiological competence of the pathogen in different climatic zones with their differing cropping patherns. In areas of low incidence exclusion becomes useful. In areas of high pathogen competence resistance becomes increasingly reliable and necessary.

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INDUCED POLYPLOIDY AS A BREEDING METHOD

by

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For almost the whole of man's existance plant improvement has been by selection, first unconscious, later conscious, at least in part. Even so little as one hundred years ago the details of pollination and fertilization were not generally understood in the process of reproduction and it was not until Mid-nineteenth century that breeders came to hear of Mendel's work, and the word 'genetics' was coined by Batason in 1906.

Thus, the practice of scientific breeding is relatively still in its infancy and for all practical purposes we may say it is but 80 years old. As plants, directly and indirectly will for long be the main source of food, clothing, drugs, fuel and construction materials, it is obvious that the major contribution of plant breeding for the welfare of mankind lies in the future.

Much of the breeding work for the twentieth century has been and is still exploratory in character. Considering the enormous wealth of genetical variation exhibited by the world plant population, there should be a great expansion in breeding as a basic necessity for a world population rapidly increasing in numbers and in its demand for a higher standard of living. Therefore, the need for a thorough study of natural phenomenon like polyploidy as a means of building weapons for man in order to fight the numerous odds that are working against his existance, is most imperative.

Perhaps, one should start by writing briefly about the phenomenon - Polyploidy. Polyploidy has time and again been a potent factor in the evolution of plants, and it has been estimated that over 40 percent of the dicotyledons and nearly 60 percent of the monocotyledons and at least a third of domesticated species (70 percent of forage grasses are polyploids).

Two main types of polyploids are polyploid varieties or Autopolyploids and polyploid hybrids or allopolyploids. Each of these may be further subdivided into euploids with a whole number multiple of genomes° (x) of the group, (e.g. tatraploid, hexaploid, Octoploid), and aneuploids whose chromosome complement is not a whole number multiple of the basic number (e.g. 2x-2: nullisomic; 2x-1: monosomic; 2x+1: trisomic; 2x+2: tetrasomic).

Euploids with an odd number of chromosome sets (triploids, pentaploids, septaploids) are characterized by a high degree of sterility owing to irregular meioses and unbalanced gamates; hence it is rarely practical to to attempt a systematic study of their inheritance. Nevertheless, some odd numbered euploids are of great importance in crops which can be propagated asexually for example, some apple and peer varieties, commercial bananas and numerous ornamental plants are triploids showing greater vigour and size than their comparable diploid types. They also comprise highly uniform clones, an advantage in such crops.

Having proved to my readers that I know what polyploidy may be about, one may wish to turn to how induced polyploidy has been a breeding method. (• a genome is the basic haploid set of chromosomes in a species)

Polyploids occupy so important a place among domesticated plants, it might be thought that the ability to create polyploids from diploids would provide such valuable advantages as to revolutionise plant improvement. This view, however, is immediately discounted when one considers the essential differences between established polyploids and newly created ones. The former have been exposed to the long-continued rigorous forces of natural selection and have been tried and tested for genetic and chromosomal balance and stability, fertility, vigour, etc. In contrast, the rawly new polyploids is untested by selection for any of the above attributes and is characteristically less competent to survive, a even when cossated by man. To put it in another way, the old genes and chromosomes are not adapted to the new and therefore alian, internal polyploids environment which they themselves comprise. Nevertheless, as better understanding of genetic principles and mechanisms has grown, induced polyploidy can now be seen to offer promising means for the manipulation of genes and chromosomes towards the synthesis of novel and improved varieties.

Much work has been done in Sweden on Autotetraploid varieties in the forage crops like alsike and red clore;. Fertility, though good in some strains is less in the tatraploids than the diploids, though hay yields have been higher, chiefly because the plants recovered more quickly after grazing. Adverse characteristics include long styles, the inability of bees to reach the nectar in the flowers and contamination of tetraploid. stands by diploids. The best diploids have not always given the best tetraploids that is the behaviour of the induced tetraploids is unpredictable. No tetraploid varieties have yet been released.

Summing up the prospects of utilizing induced polyploids, it is clear that new autotetraploids produced from a single diploid form should not be expected to be immediately successful. The way to success lies in producing a number of autotetraploids from genetically different diploid sources, followed by intensive hybridization and selection in large populations. Even though the lots of work leading to one becoming a geneticist may seem to depend on luck, I think that conscious efforts should be made to encourage Biology Students (by this I mean Botany and Zoology Students) to carry out research work in the field of cytogenetics.

It must be pointed out that some success has been achieved using triploids in commercial sugar-beet production (ELLERTON, 1967). The problem, however, of successful exploitation of triploidy has difficulties, the salient features of which are as follows: In general, triploids have larger roots than diploids, tetraploids, smaller, triploids yield the most sugar per acre. In Europe for example, the 'polyploids' (anisoploids) varieties grown are diploid-triploid-tetraploid mixtures, often in the approximate ratio of 40:60:10, produced by growing together diploid and tetraploid seed plants. Such varieties are widely grown in Europe and are predominant in European Economic Community Countries.

The only 'triploid' in cultivation is Triplex (synonymous with Trirave). This is produced by growing together a diploid that is cytoplasmically male-sterile and a tetraploid pollinator. The seed is obtained from the diploid plants. and is therefore of normal size and adapted to standard size ranges of precision drills.

Ideally, a high degree of cytoplasmic male sterility is necessary, not influenced by environmental conditions as is the case with much sterile material. The attainment of complete homozygosity in the parent used to maintain male-sterile lines is made difficult on account of beet being nearly self-incompatible.

In breeding for better male-sterile lines, a further complication arose in that the tetraploid plants employed as pollinators had thicker and stronger anther walls which needed a drier atmosphere than the diploid before they burst and shed their pollen, thus reducing the efficiency of pollination. As a result, the percentage of triploids produced from the interplanting of diploids and tetraploids was found to vary from 90 percent in favourable years down to 60 in unfavourable ones. The diploid component in the triploid varieties came occasionally from male-sterile plants and from normal diploid beet, bolters, wild beet, red beet, etc. Thus although the beneficial effect of triploid [illegible] was satisfactory, yields varied year to year, from very good to very bad, especially because of bolting.

Many individual lots of triploid-test-hybrids have given phenomenal results, but reselection of tetraploids for easier pollen shedding, better performaing male-steriles, and improved techniques for preventing contamination by pollen from outside sources, are all necessary before triploid sugar-beet can become as successful as its potential promises.

Sugar-beet, therefore, affords a good example of the intricate problem which have to be solved by the breeder in the commercial exploitation of polyploidy.

In conclusion therefore, though success may appear not too often attainable, at least a case in point may be given. Lupins normally contain alkaloids which give them protection against grazing animals, hence alkaloid-free mutants are at a disadvantage in the wild, but would provide valuable fodder crops in cultivation. Von Sengbusch (VON SENGBUSCH and ZIMMERMANN, 1947) found only six alkaloid-free individuals out of 1,500,000 plants tested and, from the progeny of these, 10,000,000 plants were raised before one individual was found with pods that did not open and so retained the seeds. (HACKBARTH and TROLL, 1956). But then, it is my strong belief that the scope, the opportunity and the challenge are potentially immense - and immensely rewarding.

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SEX DETERMINATION

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The studies of sex determination are associated with three persons within the present century.

The first investigations relating chromosomes to sex determination were carried out at the turn of the century. A German Biologist, H. Henking, in 1891, discovered that a particular nuclear structure could be traced throughout spermatogenesis of certain insects. This structure was received by only half while the other half of the insects did not receive any. Henking only identified this as the "X body" and shared that sperm differed because of its presence or absence.

In 1902 these observations were extended by C.E. McClung who made cytological observations on many different species of insects (grasshoppers) and demonstrated that the somatic cells in the female grasshopper carry a different chromosome number than do corresponding cells in the male. While he was able to follow the "X body" in spermatogenesis he did not succeed in tracing the oogenesis of the female grasshopper. McClung associated the "X body" with sex determination, but wrongly considered it to be peculiar to males.

Again contributions to basic knowledge about sex determination were made in the early part of the century by E.B. Wilson and his associates. He reported expensive cytological investigations on several different insects notably from the germs Protenor-an uncommon group of insects closely related to the boxelder bug. In these insects different numbers of chromosomes were observed in the germ cells of the two sexes. He traced oogenesis successfully as well as spermatogenesis and found that the unreduced cells of the male carried 13 chromosomes, and those of the female had 14. Investigations also shoul that some male garmetes carried 6 chromosomes, whereas others from the same individual carried 7. Eggs fertilised with 6-chromosome sperm produced males while those fertilised by 7-chromosome sperm produced females.

MECHANISM OF SEX DETERMINATION

In Henking's investigations, the "X body" was thus found to be a chromosome that influenced sex determination. This was identified in several insects and became known as the sex or X chromosome. All eggs (female gametes) of these insects carried an "X" chromosome, but it was only included in half of the sperm (male gamete). However, all sperm had the usual complement of other chromosomes-antosomes (chromosomes that are not sex ones). Thus eggs fertilised by sperm containing the X chromosome produced zygotes with two X chromosomes, which became females. Eggs receiving sperm without an X chromosome produced zygotes with one X which became females.

Another chromosome arrangement was observed by Wilson in the bug- Lygaeus turicus. In this insect the same number of chromosomes was present in the cells of both sexes. The one certified to be a mate to to the X, however, was distinctly smaller and was called the 'Y' chromosome. Any sex determination based on equal chromosome numbers in the two sexes, but with different kinds of chromosomes making up one pair, was called the XY type. According to evidence accumulated from a wider variety of animals, the XY mechanism was found to be more prevalent than the XO. the XY type is considered a characteristic of most higher animals, e.g. man.

In some plants it is also found, e.g. in Melandium album. The human X chromosome is longer than the Y chromosome. The total complement of human chromosome includes 44 antosomes. The antosomes are XX in the female and XY in the male.

During oogenesis, eggs produced by the female have the usual complement of antosomes-22 and an X chromosome. Spun from the male have the same 22 autosomal number, but either with an X or Y chromosome, called heterosome.

Eggs fertilised with Y chromosome sperm result into zygotes that develop into males; while those fertilised with X chromosome sperm result into zygotes which develop into females. Segregation of the XY pair and random fertilisation thus explain, at least superficially, why some individuals develope into males, and why about half of the numbers of each population of higher animals are males and half are females.

Historically, the association of the most conspicuous phenotype (that is, sex) with a particular chromosome greatly strengthened the hypothesis that genes are in chromosomes. This idea originally had been postulated largely because of the parallel observed between the separation of chromosomes in the meiotic process and genetic gre segregation.

THE BALANCE CONCEPT OF SEX DETERMINATION

As soon as sex chromosomes were identified it became obvious that sex determination was more complicated than preliminary observations had indicated. A more puzzling mechanism than the segregation of a single pair of chromosome was evidently shown. Bridges contributed immensely to the definition of this mechanism by making some investigations on the fruit-fly.- Drosophila Melanogaster.

This showed thatfemale determiners were located in the X chromosome and male determiners were located in the autosomes. More than one gene in the X chromosome were found to influence femaleness. Bridges also demonstrated that genes for malenessswere not located in the Y chromosome of Drosophila Melanogaster, but were widely distributed among the autosomes No specific loci have been identified and the present evidence suggests that many chromosome areas are involved. Thus it was shown that sex-determining genes are carried in certain chromosomes in Drosophila Melanogaster, and that all individuals carry genes for both sexes.

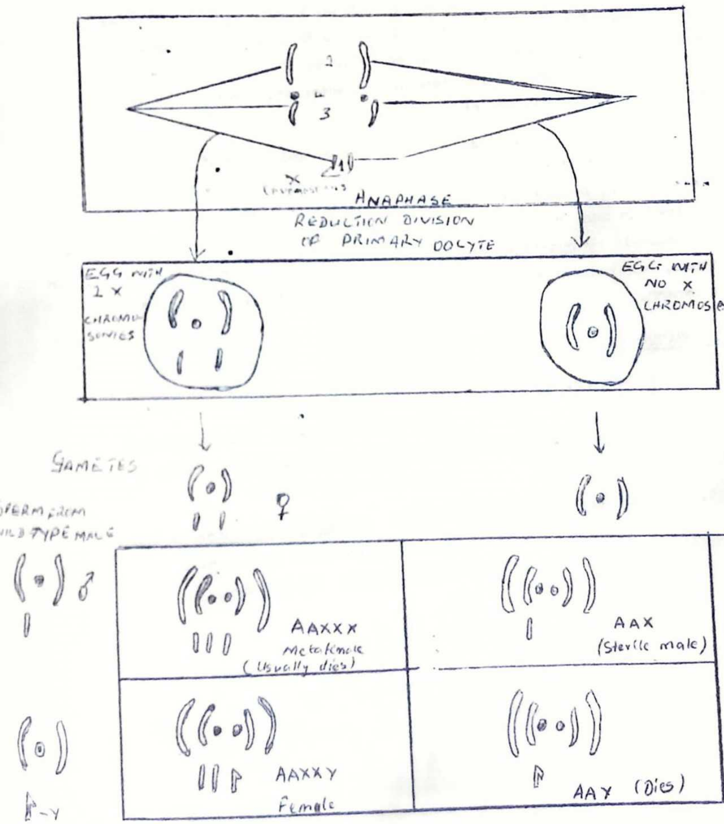
The XO or XY chromosome segregation was interpreted as a means of tipping the balance between maleness and femaleness, whereas more deep seated processes were involved in the actual determination. Bridges experimentally produced various combinations of X chromosomes and autosomes in Drosophila Melanogaster and deduced from comparisons of the results that one X chromosomes (X) and two sets of autosomes (A) had a ratio terms of sex determining capacity of ½ or 0.5. This combination of X (IX) and 2A resulted in a male, while 2X and 2A resulted in a female. See table I overleaf.

X CHROMOSOME (X) AND SETS OF AUTOSOMES (A)		RATIO OF X/A	SEX
1X	2A	0.5	MALE
2X	2A	1.0	FEMALE
3X	2A	1.5	METAFEMALE
4X	3A	1.33	"
4X	4A	1.00	FEMALE TETRAPLOID
3X	3A	1.00	TRIPLOID FEMALE
3X	4A	0.75	INTERSEX
2X	3A	0.67	"
2X	4A	0.5	MALE
1X	3A	0.35	MATAMALE

Ratio of X chromosomes to autosomes and corresponding sex type in Drosophila melanogaster (after bridges)

The first irregular arrangement of chromosemes from Bridges experiments resulted from non-disjunction. This non-disjunction is the inability of paired chromosomes to separate after anaphase of meiotic division. These two chromosomes then went together to the same pole. Consequently, some female gametes received two X chromosomes and some had none at all.

See Figue I Below: NON-DISJUNCTION IN *Drosophila melanogaster*



Following fertilisation by wild type D. melanogaster males with AAXY all zygotes had 2A autosomes (AA or 2A), but some received two X from the mother and an X from the father to produce 3X. The ratio of 3/2 instead, resulted in their called metafemales that are highly inviable. The XXY flies (2X/2A from the same mating were normal females in appearance; XO or IX/2A or 0.5 ratio males were sterile while those with a Y but no X chromosomes did not survive. These results indicated that, in D. melanogaster, the Y chromosome is not involved in sex determination, but that it does control male fertility.

Flies produced experimentally with 4X/3A were also metafemales also called superfemales. Those with 4X/4A and 3X/3A both with X/A-1, were females: The combinations 3X/4A or 0.75, and 2X/3A-o.67, produced experimentally were intermediate in characteristics between males and females and were called intersexes.

Combinations of X 2X/4A -0.5 were males and those of IX/3A-0.35 were metamales. No other animals or plants have been investigated with equal thoroughness, but indirect evidence suggests that some such balance is involved in many organisms. Intersexes can be produced experimentally in some animals by upsetting this balance during the developmental stages. In nature, a margin of safety makes intermediates between the two sexes uncommon.

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THE USE OF GROWTH REGULATORS TO AID CROP PRODUCTION

by

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INTRODUCTION:

The growth of a plant is a dynamic and complex, yet strictly controlled, process. Growth of the single-c lled organism is complicated enough, involving the processes of cell enlargements and organelle production but with the development of multicellular plants, complexity is increased with the additional problems of co-ordination of the action of various cells in the organism. The co-ordination of growth between different parts of the plant must clearly involve some control mechanism.

Moreover, the development of organs, such as leaves or stems, involves an orderly sequence of phases cell division and cell extension, so that there is also co-ordination of growth in time. But lack of co-ordination and specialization of cell activities, automatically results in only a colony of cells without the special advantages of the mullecellular organism. To this effect, there are two evident types of mechanisms which can be employed to bring about co-ordination in the plant.
Firstly, system of chemical messengers which direct cells to carry out various functions and secondly, the system of field or physical forces. The former class includes the plant hormones while the latter might involve electrical gradients over the entire plant or meterbolic presence or gas-exchange gradients.

Other types of cellular control may exist but at present most physiologists, are unaware of them. Taking into consideration the present state of knowledge, most attention will be diverted to hormonal and chemical control systems in order to develop a logical picture of how cells are regulated in growth, expansion and differentiation.

The end product of these controls is a complex plant organism with localized regions for photosynthetic activities, translocation of materials, or differentiation in reproduction or other specific activities. With all these mechanisms involved, chemicals which may participate in the control of growth are called GROWTH REGULATORS. Four types of these growth regulators have been recognized by plant physiologists: Auxins, Gibberellins, Cytokinins and the Growth Regulators.

As for intact organs of whole plants far more is known about auxin than any other growth substance. About the 1930's, it was realised that growth in length of an organ may at times be retarded by the growth promoting substance and these were again referred to as Auxins.
More recently came the discovery of gibberellins, cytokins and some growth inhibitors, which would be discussed later inrelation to their physiological activities, singly and in association.

HISTORY OF DISCOVERY

AUXIN: The presence of growth regulating hormones in plants was first suggested by Julius-Von-Sachs in the latter half of the Nineteen Century when he proposed that there were "organ forming substances in plants, which were produced in the leaves and translocated downward in the plant. The basis of our modern knowledge of ins lies in the work of Charles Darwin, published a Century ago in a book entitled "The Power of Movement in Plants." Darwin investigated the phenomenon of phototropism, the response of plant organs in response to unilateral illumination and latter concluded that "When seedlings are freely exposed to a lateral light some influence is transmitted from the upper to the lower part, causing the latter to bend." It was much later that researchers such as Boysen-Jensen (1910) and Paal's (1919) found out the nature of this influence. The first successful isolation of the chemical messenger noted as the influence was carried out in 1926 by a Dutch Professor, F. Went who thus extended the work of other researchers mentioned earlier. After some experiments he gave the name AUXIN, to the growth 'hormones which are present in all higher plants which are of importance in the physiology of growth and f differentiation.

GIBBERELLINS: The gibberellins now recognised as having great importance in the normal physiology of the plant were discovered through an analysis of a plant disease which had devastating effects on the rice economy of Japan. Japanese farmers noted that plants affected with this disease were taller, paler and thinner than their normal counterparts and sometimes devoid of fruits. (Phinney and West 1961). Japannes plant pathologist later revealed that they were infected by a fungus called Fusarium moniliforme which was later identified b to be an ascompcete a called Gi;bberalla fujikuroi. After series of experiments by some physiologists, Yabuta and Sumiki (1938), isolated the crystalline gibberellin which was given the name Gibberelin A (GA).

CYTOKININS:

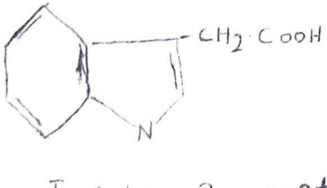
This discovery came from work done with cultures of young plant embryos and tissue explants. Studies by Habalandt (1919) demonstrated the existence in plant tissues of a diffusible factor which stimulated parenchymatons cells in potato tubers to revert to a meristematicstate. That is, cell division could be induced by the factor. Cceonut milk found as a stimulant of cell division was supported by many researchers like Van-VeerBeek (1914).

The most exciting discovery in the search for compounds that will induce cells to multiply is Kinetin.

Other classes of plant hormone exist, particularly the growth inhibitors such as Abscisic acid (ABA) and also the gas ethylene which is apparently involved in many growth phenomena. Abscisic acid was isolated from cotton fruit and was found to possess a broad spectrum of biological activity.

CHEMICAL NATURE OF THE GROWTH REGULATIONS

AUXIN - Attempts to isolate and chemically identify auxin suffered from the difficulty that it is present in plant tissues in extremely small quantities. It was found to be impossible at that time to obtain sufficient auxin from plants to prepare pure crystalline auxin for analysis. Infact the first crystalline auxin was obtained from human urine and after determining the chemical nature, it was shown to be HETEROAUXIN or as it is known today as Indola-3-acetic acid (IAA):

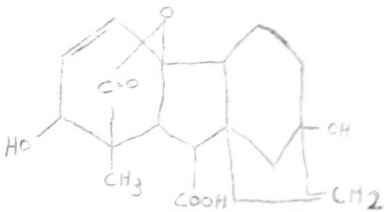


Indole - 3 - acetic acid.
[IAA]

Other substances were subjected to investigations and the substances obtained were found to be similar to IAA action even when applied at low concentration. These substances now referred to as SYNTHETIC AUXIN include-Indole-3-propionic acid; indole-3-pyruvic acid, 2,4, dichloro-phenoxy acid; 4, 5, trichlorophenoxyacetic acid and 4, chloro-2 methyl-phenoxyacetic acid (MCPA). Went and Thiamin (1937) concluded that the degree of substitution in the ring and side chain, nature g of ring and length of the side chain are the factors that will influence auxin activity.

CHEMISTRY OF GIBBERELLINS

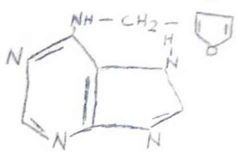
The chemical composition and structure of gibberellin compounds have now been known. Their biological activities similar to that of the original gibberellin isolated from the fungus G. fujikuroi. So far thirteen naturally occurring gibberellins have been found, all having very similar chemical structures (Paleg 1965). All the said thirteen compounds possess the same general carbon skeleton and all are able to promote growth system in plants.



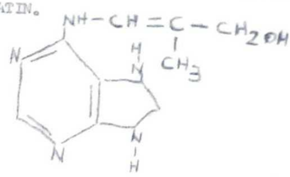
Gibberellic acid (A_3 ($C_{19}H_{22}O_6$))

CHEMISTRY OF CYTOKININS

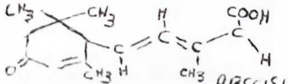
The first compound with a hormal activity isolated from natural resources was kinetin; but the naturally occurring cytokinin was isolated from Zea mays grains and appropriately named ZEATIN.



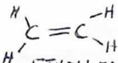
KINETIN



ZEATIN



ABSCISIC ACID



ETHYLENE

The chemical composition of the two growth inhibitors—Abscisic acid and ethylene has been elucidated. Abscisic acid was isolated from cotton fruit while ethylene possesses a simple molecule contrasting with the more chemically complex gibberellins, cytokinins, auxins and (ABA)

PHYSIOLOGICAL ROLE OF THE GROWTH REGULATORS

We may reasonably assume that the distribution and concentrations of auxins, gibberellins and cytokinins, together with growth regulators are vital factors in the overall control of growth and differentiation in the whole plant.

ROLE OF AUXIN

Extensive studies of auxin have revealed that in some plants auxin is stimulatory, in others inhibitory, and still in other cases a necessary participant in the growth activity of another plant hormone.
The important function of auxin is its ability to stimulate cell elongatio Occurrences of phototropism and geotropism in plant can also be attributed to an unequal distribution of auxin. It also plays an important role in Apical dominance, it induces parthenocarpy, (a phenomenon referring to the development of fruits without any associated development of viable seeds), effective in ripening of fruits, controlling factor in abscision (falling of leaves) and cell divisioh. Synthetic auxins are used as weed killers.

Role of Gibberellins:

Gibberellins rival auxins in the multiplicity of growth reactions which they evoke in plants. They contributed to the promotion of cell elongation by altering the growth of a dwarf plant variety, they also induce parthenocarpy in some fruits, e.g. tomato, apple, grape, etc. root elongation, leaf expansion, seed germination, breaking of dormancy and mobilization of storage compounds during germination (i c cereal e.g. grain)

Role of cytokinins:

The stimulation of cell division in plant tissue was the first effect of kinetin to be observed and for that to be in a continuous process, it goes in association with auxin.

It plays a better role in to root formation, e.g. lettuce. and tobacco, it also delays senescence (yellowing of leaf) and it can also break seed dormancy.

Role of Abscisic Acid:

After elaborating with regulators involve in acceleration of growth, abscisic acid has been noted to be a growth retardant and a suppressor that is by promoting abscission (leaf fall), promotion of dormancy, growth retardation and indication of senescence.

Role of Athylene:

This hormone basically contributes to the ripening of fruits but it also act as a retardant of growth by promoting abscission and induction of epinasty (downward bending).

PROBLEMS INVOLVED AND HOW THEY ARE OVERCOME

There are some effective problems which are relatively affiliated to inhibition of plant production. Notably amongst these are abscission and senescence. Abscission refers to the removal of leaf c from the plant while senescence is the yellowing of leaves. Obviously, abscisic acid is a contributing factor to the abscission of a leaf or fruit but the application of indole-3-acetic acid invariably stops the action of abscission. In relation to senescence, kinetin delays the onset of senescence in the leaves, and cytokinins in general have a senescence delaying effect on plant tissue. Abscisic acid also contributes to the inhibition of seed germination-an effect which is equivalent to a prolongation of seed dormancy. Kinetin is a controlling factor in breakage of dormancy.

One other important problem encountered by plants is their reaction to injury which may be physical injury or invasion by pathogens. The nature of the reaction to the pathogen determines whether the plant is susceptible or resistant to the disease caused by the organism Habeirlandt (1953) later suggested that cytokinin may be more importantly involved in the wound reaction by controlling the effect. Virus infection can also partitipate in auxin reduction in an infected plant but this can be overcome by the application of gibberellic acid.

RESULTS OBTAINED

Relative to most of the work done, plant growth hormones are becoming useful tools in agriculture and horticultural practices. The earliest commercial use of a plant hormone was the exposure of fruits to ethylene gas to accelerate ripening, a practice which is still common today. The usefulness of auxins and gibberellins in inducing partheno carpic fruit development has been mentioned by but another practical use of auxins is the induction of flowering and consequently fruiting by spraying pineapple crop with compounds such as 2,4 dichloro-phenoxyacetic acid (synthetic auxin). Another special merit of synthetic auxin is their use as a selective herbicide in certain fields without affecting the surrounding crop plants, e.g. yellow charlock (sinapis arvensis) can be controlled within certain crops such as oat (Avena) or wheat (Triticum). Another important result obtained was observed in the difference in action of gibberellin and auxin in the induction of parthenocarpic fruits. Derlin and Demovanvill (1967) observed that gibberellin is more reliable in producing some fruits than auxin, e.g. ponne and stone fruits are effective to only gibberellin.

Strawberry plants can by treatment with gibberellic acid be induced to produce earlier flowers and therefore fruits than untreated plants These have actually contributed to commercial gain strawberry.
The most important single application of gibberellins yet found is in the malting industry and malting is a process whereby barley seeds are allowed to germinate for several days. The germinated seeds are used in the preparation of a medium for fermentation yeasts in the manufacture of BEER. It has also been claimed by Macleod (1962) that pasture grasses, when sprayed with gibberellic acid, grow more "rapidly and are more valuable nutritionally for grazing animals. In the case of kinetin, not much work has been done on its independent mode of action towards growth, but it has been found to induce parthenocarpy in egg plant (solanum melongena) when in association with GA and IAA, (Oliopus 1976°)

SUMMARY & CONCLUSION:

A number of examples of interactions among plants hormones have been described earlier and it is probable that no specific physiological response of crop production can be ascribed to the influence of only one kind of hormones Such interaction may be synergistic in which case one hormone reinforces the effect of another; or antagonistic in which all one hormone offsets or retards the effect of another.
An example of antagonistic effect is the balancing of the abscission-delaying effect of IAA with abscisic acid. There is very little doubt that practical uses of plant hormones will in future be more extensive and varied than at present. Full realization of their potential will, however, not be achieved until our understanding of their functions and mode of action in plants is greatly increased.

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«FRONTIERS OF KNOWLEDGE»

The Editorial Board of the "Euphorbia" has introduced, starting from this third issue of the journal, a series of short stimulatory articles by eminent lecturers and researchers designed to acquaint students with some modern trends in Botanical Advancement and thereby expose them to the frontiers of knowledge. Such articles will be in the form of review articles and/or research endeavours in various fields of Botany.

We have the pleasure to request Dr. C. O. Akueshi, one of the founding fathers of this Department, and Lecturer in Plant Pathology to present the first of these articles.

MYCOPLASMAS AND PLANT MYCOPLASMA DISEASES

by

DR. C. O. AKUESHI

During the last fiffy years, many significant advances have been made in the field of plant pathology, and not the least among achievements is the progress made in our understanding of the role of mycoplasmas and mycoplasmas-like agents in inciting the diseases of plants. The mycoplasmas bacterial of the order mycoplasmastales, are about the smallest organisms known to be capable of autonomous living. Many diseases of ma animals and plants formerly thought to be virale in their aetiology are now known to be caused by microplasmas. These extremely minute organisms are even known to be capable of infecting cell cultures.

Over the years the study of these organisms and their diseases has been limited to hosts such as man, animals and insects. Among the diseases mycoplasmas produce in man are primary atypical pneumonia and urogenital disorders. In animals they are responsible for specific types of pneumonia-especially contagious bovine pleuropneumonia and contagious caprine pleuropneumonia which are well recognised in Nigeria. Other conditions in which mycoplasmas are involved are mastitis, arthritis, and urogenital tract and eye infections in animals, and chronic respiratory diseases and arthritis in poultry, as well as fatal brochopneumonia and neurolytic disorders in rats and mice (Adegboye, 1977a, 1977b).

Evidences are now becoming overwhelming that these organisms may also be responsible for many disorders in plants. There have been reports from France about disorders of Vinca rosea, Solanum melongena Lycopersicum esculentum, Capsicum annuum, Apium graveolens, Daucus carota, Calendula officinalis and Callistephus chinensis. Reports of the Citrus stubborn disease, Aster Yellows disease and the Coconut Lethal Yellowing disease-all caused by mycoplasmas-have come from America, Canada, Jamaica, England, India and Malaya.

Mycoplasmas are rather fastidious and require complex growth substances. Consequently, only few people have been skilled, and few laboratories have been equipped to check for them during routine diagnostic services. In fact, in Nigeria only little work has been reported from the National Veterinary Research Institute, Vom; Department of Pathology and Microbiology, Ahmadu Bello University, Zaria and the Department of Veterinary Pathology of the University of Ibadan, on animal mycoplasma diseases. No work has so far been reported on plant mycoplasma diseases, which, in every likelihood must exist here in Nigeria.

It is therefore with a view to stimulating the interest of Botany Students to plant diseases caused by mycoplasmas, the Biology of these organisms, the methods of isolating and propagating them, and the methods of controlling the pathogens and the diseases caused by them, that this article is devoted.

CLASSIFICATION AND BIOLOGY:

Mycoplasmas are extremely minute organisms. They are members of the Class Mollicutes-organisms with "soft and pliable skin." The class consists of one Order, Mycoplasmatales, together with two loosely attached genera, Thermoplasma and Spiroplasma. The order itself contains two families, Mycoplasmataceae and Achollepplasmataceae. The former family has two genera, Mycoplasma and Ureaplasma, and the latter family has only one genus, Acholeplasma. This evolutionary approach to classification in the Class Mollicutes was suggested by Edward (1974).

Pelczar and Reid (1974) have reported that the elementary bodies of mycoplasmas contain strands of DNA and are filterable, being only 0.125 to 0.250 Um in diameter. In culture they germinate forming branching filaments ranging from 2 to 15 Um in length. These filaments assemble as chains of spherical corpuscles which later fragment into new elementary bodies.

One unique feature of mycoplasmas is their lack of a rigid cell wall. The cells are instead bounded by a trilaminar cell membrane. Recent studies have shown that this lack of rigid cell wall offers no impediment to movement because some wall-less mycoplasma (notably mycoplasma pneumoniae) can glide on a glass surface in a liquid medium and at a speed comparable to the movement of Myxobacteria, about 15-30 Um/min. (Murray, 1978). However, Meadow (1978) has noted that one consequence of the lack of cell wall in mycoplasmas is that when grown in the presence of sterols, they incorporate them into their cytoplasmic membrane. But when grown without sterols, mycoplasmal membranes do not contain these compounds and the organisms are resistant to the polyene antibiotics. In contrast, bacterial membranes contain no sterols, do not bind these polyene antibiotics and are therefore not affected by them. Another consequence of the lack of cell wall in mycoplasmas is that they are pleomorphic and take on various shapes as induced by their environment.

Mycoplasmas grow on agar medium forming small colonies with an opaque and yellowish central area which is surrounded by a transluscent peripheral zone, thus giving the colonies a typical "fried egg" appearance. Mycoplasmas are gram-negative and non-spore-forming.

GROWTH AND CULTIVATION:

Mycoplasmas are known to be fastidious in their growth requirements (Pelczar and Reid, 1974; Adegboye 1977), and so there is no one medium which can grow all mycoplasmas. Among all mollicute-like organisms associated with and presumed to induce disease in plants, Spiroplasma citri, the citrus stubborn organism, remains the sole example that has been isolated and cultivated in vitro, characterised, shown to be plant pathogenic, and assigned a Latin binomial name. In morphology, ultrastructure and motility, the corn stunt spiroplasma appears to be closely related to the citrus stubborn spiroplasma. Their requirements for isolation and cultivation in vitro are therefore similar. Davis and Worley (1974).

I have reported that in liquid medium, the corn stunt and citrus stubborn spiroplasmas grew well and exhibited vigorous rotational and flexional movements but achieved no significant translational movement. Use of a semi-solid (0.25% agar) medium adopted for the cultivation of Spiroplasma citri, however permitted the demonstration (documented by phase contrast cinematography) that the spiroplasmas are capable of accomplishing contractile movements when grown on a semi-solid medium containing a cystine-tryptone-sodium sulphite basal medium with supplements. S. Citri will also grow well on a medium solidified with 1% agar. Fudl-Allah et al (1972) have also reported the successful use of both liquid and agar media to culture a mycoplasma-like organism associated with stubborn-diseased citrus in California. All media used successfully contained either horse serum or ascitic fluid and also in liquid media containing either 20ml ascitic fluid or 2mg cholesterol and 1mg palmitic acid instead of horse serum. Excellent results were obtained with a medium containing 2.1g. Difco PPLO broth, 0.1g. fructose, 0.1g. glucose, 0.1g. sucrose, 0.1g. tryptone, 5.09g. sorbitol, 20ml horse serum, 10ml 25% fresh yeast extract, and 60ml distilled water. The ingredients, excepting horse serum and yeast extract which were passed through a 0.2U filter, were adjusted to pH 7.5 to 7.8 and autoclaued at 121°C (15 psi) for 20 mins. The complete medium was distributed in sterile flasks, 5ml in each, and kept at 4°C until used. A similar solid medium (3.4g. Difco PPLO agar replaced the PPLO broth) was used for primary cultures. Adegboye (1977) has also succeeded in culturing metabolite forms (glucose, arginine, or urea utilizers) of mycoplasmas involved in diseases of the respiratory and urogenital tracts, joints, eyes and mammary glands in both broth and solid media. The broth consists of seven parts Difco PPLO Broth, two parts unheated. Welcome horse serum No. 6 or Difco dessicated horse serum, one part 25% fresh yeast extract, 1000U of benzylpenicillin sodium, 0.02% thallium acetate, and 0.002% phenol red. The penicillin and thallium acetate are bacterial inhibitors. 1% glucose, arginine or urea is added to the above constituents for detecting glucose, arginine-, or urea- utilizing mycoplasmas, respectively. Thallium acetate is omitted from urea-supplemented media because Ureaplasma sp have been shown to be sensitive to this chemical. The pH of the medium is adjusted to 7.6 if it contains glucose, and approximately 6.0 it is contains arginine or urea, using IN HCl or IN NaOH as needed. The complete medium is dispensed aseptically in 100ml aliquots, stored at +4°C and used within four weeks. The recipe for the solid medium is the same for liquid medium except for the addition of 1% oxoid Ionagar No. 2. The medium is dispensed into sterile plastic petri dishes and also stored at +4°C before use.

Temperature and pH, amongst other factors, are known to influence to the growth of mycoplasmas in cluture. Fudl-Allah and Calavan (1972) showed that a mycoplasma-like organism associated with stubborn Disease of Citrus grew from pH 4 to 8 with an optimum at pH 7. They however suggested that for routine use, a medium should be adjusted to about pH 7.5, to offset the decrease in pH resulting from growth of the organism. They also reported that the organism grew from 9° to 39°C with an optimum at 30°C. Colonies formed on agar media at 9°, 12°, 15°, 18°, 21°, 36°, and 39°C were few and small. But larger colonies appeared at 24° to 33°C with optimal growth at 30°C. The organism was viable after storage for 2 weeks at 4°C or for 2 months at - 20°C. It should be noted that the optimum temperature for growth of this mycoplasmalike organism falls within the 28° - 33°C range found favourable for symptoms of the Citrus Stubborn Disease by Professor E. C. Calavan. Similarly Gill (1962) has shown that the avian Mycoplasma gallisepticum has an optimum temperature of 38°C, which correlates to its natural occurrence in birds having relatively high body temperatures.

AETIOLOGY, SYMPTOMOGY AND EPIDEMIOLOGY OF PLANT MYCOPLASMA DISEASES WITH SPECIAL REFERENCE TO THE CITRUS STUBBORN DISEASE:

Of the many diseases of plants caused by mycoplasmas and mycoplasmalike organisms, the best studied is the stubborn disease of citrus. Quite recently however some work has been carried out on the Aster Yellows Disease and the Coconut Lethal Yellowing Disease. Calavan and Gumpf (1974) believe that the disease now popularly known as the Citrus Stubborn disease has been present in California and the Eastern Mediterranean for more than 50 years. It was first observed near Redlands, California about 1915 and is now common in most arid citrus areas of the northern hemisphere, but rarely causes damage in cool or humid regions.

The origin of the disease California and the Eastern Mediterranean is unknown but its extensive spread resulted in the infection of 2 million citrus trees in America and 54,000 trees in Israel alone.

The term stubborn was first used by a citrus propagator to describe the poor response of trees top-worked with select buds in 1921, but stubborn was first used as the disease name in 1929 by J.C. Perry who concluded that some influence was transmitted from stubborn trees into apparently good buds used in top-working.

Symptoms of the disease on leaves and shoots include small, abnormally upright leaves, bunchy or rosette foliage and numerous short leafy branches, growth from multiple axillary buds and foliar chloroses resembling deficiency patterns. Leaves become pinched at the tip or become cup-or heart-shaped. Growth becomes stunted and there is premature defoliation, and finally twig dieback. Symptoms associated with fruiting include heavy normal and unseasonal flowering and excessive fruit drop. The fruits themselves are acorn-shaped or lopsided with a curved columella. Mature fruits are paler than normal and [illegible] especially on the stylar end.

The fruits are generally small and of low yields and have insipid sour or bitter flavour and abnormal, occasionally bluish albedo (Calavan and Carpenter 1965; Calavan and Christiansen, 1966; Hilgeman, 1961, Calavan, 1969)

It is known that all commercial varieties of citrus appear to be susceptible to the stubborn disease when graft inoculated, but in California, Calavan and Gumpf (1974) reported that natural infection occurred mostly in sweet orange grapefruit and tangelo trees. Navell orange and grapefruit trees are most severely damaged. Some stubborn-affected lemon, Valencia and Madam Vinous sweet orange trees improve with time but rarely, if ever, recover completely.

Calavan (1969) and Igwegbe (1970) had earlier assumed stubborn to be a virus disease because of its ability to be graft transmitted. But the first indication that it might be due to a mycoplasma-like organism came in 1968 when Igwegbe (1970) discovered that tetracycline, but not penicillin, suppressess stubborn symptoms. Recent researchers have however reported Spiroplasma citri in vitro to be sensitive to concentrations of less than 1.0Ug/ml of actinomycin D, carbomycin, demethylchlortetracycline, doxycycline, evythromycin, methacycline, minicycline, and tylosin. Tetracycline, although effective in hydroponic solution and in vitro, has not benefited citrus trees injected with it. Mycoplasma-like structures were first observed independently in the sieve tubes of stubborn-infected leaves of citrus in California (Igwegbe and Calavan, 1970) and France (Lafleche and Bove (1970). Later in the same year the organism was cultured, again independently, in both laboratories. The organism was first called Spiroplasma citri in 1972. Similarly, a Spiroplasma sp has been associated with the corn stunt disease that causes severe stunting and proliferation in all U.S. corn varieties (Maramorosch, 1974).

SPREAD AND TRANSMISSION:

The stubborn disease organism may be spread both by natural means and by propagative material. Calavan (1969) has reported that although no uninoculated seedlings grown in the green in the greenhouse, including hundreds from seed of stubborn sweet orange and tangelo trees, have ever developed stubborn symptoms several unbudded naturally infected seedlings and many naturally infected trees propagated from nucellar seedling budlines have been found in several experimental orchards. The stubborn organism has also been spread by scion from infected trees, including some trees that show few symptoms. Most of the spread of the stubborn organism appears to occur during the months of June to October when leaf hoppers are abundant (Calavan and Gumpf, 1974). This therefore implicates leaf hoppers in the transmission of plant mycoplasma diseases.

Results of recent studies show clearly that leaf-hoppers are decidedly the principal agents of transmission of plant mycoplasma diseases. Chapman (1974) has reported that the aster yellows pathogen is transmitted principally by the aster leafhopper, Macrosteles fascifrons (Stal) to economic crops such as lettuce, carrot, celery, potato, flax, and many ornamentals. Clover club leaf disease has also been experimentally transmitted to Trifolium incarnatum, Vinca rosea and a few other plants by the females of Agalliopsis novella (Liu and Black, 1974). In India, Mycoplasma-like organisms in potato plants affected with purple top roll (PTR) disease, marginal flavescence (MF), and Witch's Broom (WB) have been transmitted by the leaf hopper vector, Orosius albicinctus distant (Nagaich et al, 1974). In California, Circulifer tenellus, the beet leafhopper, as well as Scaphytopius nitridus, and Scaphytopius delongi have been reported to be vectors of stubborn (Catavan and Gumpf, 1974). These leafhoppers feed on citrus and Spiroplasma citri has been repeatedly cultured from them in the laboratory. Circulifer tenellus is a natural carrier of S. citri, even in some areas far removed from citrus. Oldfield et al (1977) have also reported that laboratory-reared Scaphytopius nitridus, a leaf-hopper that reproduces on citrus in Southern California, transmitted Spirophytopius nitridus, a leaf-hopper that reproduces on citrus in Southern California, transmitted Spiroplasma citri from stubborn-diseased citrus to healthy sweet orange seedlings. This is the first report of insect transmission of S. citri from citrus to citrus. And, in England Spiroplasma citri has been transmitted to white clover and other plants by means of leafhoppers (EUSCELIS plebejus Fall). injected with cultured S. citri (Markham and Townsend 1974) The possibility of transmission of S. citri through infected seeds is being investigated. Recently also, Calavan, et al (1976) showed that the leaf hopper Scaphytoplius nitridus (De Long) could transmit Spiroplasma citri to a weed, London rocket, Sisymbrium irio L. and a vegetable, the purple Top White Globe turnip-Brassica rapa L. Thus, London rocket became the first weed, and turnip the first vegetable to be found naturally infected with the stubborn agents. The significance of S. citri in these two hosts is that they may serve as over wintered hosts. Thus the existence of natural non-citrus plant hosts, two of them belonging to the mustard family, suggests that there may be others, some or all of which may be important in the overall stubborn problem. The same may be true for other plant mycoplasma diseases. For this reason there is an intensive search, in California, for stubborn-diseased plants and weeds with the stunted, yellowed and deformed symptoms with a view to finding out their causal agents.

CONTROL:

In the view of Maramorosh (1974), plant disease, irrespective of their causes should be primarily controlled by prevention rather than by therapy. The prevention of plant diseases caused by mollicutes such as spiroplasmas and mycoplasma-like organisms (MLO) or by walled, rickettsialike organisms (RLO) can be carried out through breeding and selection, as well as through interfering with the vector transmission.

Long before the causative agents of MLO diseases were recognised, the spiroplasma of corn stunts that causes severe stunting in all U.S. corn varieties had been observed not to stunt the Mexican Indian varieties Chiapas 20 and Oaxaca 40. These Mexican Indian varieties showed no signs of corn stunt, nevertheless, they contained the corn stunt spiroplasmas which could be acquired and transmitted by corn leafhoppers. Crosses between these resistant varieties and improved, susceptible U.S. varieties are now being developed in Mexico. In the same way resistance to mycoplasmalike organisms of the coconut lethal yellowing disease has been observed in the Malayan Dwarf palms. Consequently, crosses between the resistant Malayan Dwarf palms and the highly susceptible Jamaican fall palms now show considerable resistance to the coconut lethal yellowing disease.

Maramorosch (1974) also reported that the prevention-of aster yellows MLO infection was affected by covering the plants with screens that efficiently excluded the MLO-carrying vectors. This method is still being practiced by aster seed producers. Insecticides on the otherhand, do not effectively prevent the spread of aster yellows, because of the abundance and efficiency of the leafhopper vectors. However, in cranberry bogs, applications of insecticides once every 2 years have controlled the spread of cranberry_false blossom MLO, because the vectors produce only one or two generations a year, and the leafhoppers that feed mainly on cranberry plants are comparatively inefficient transmitters. Calavan and Carpenter (1965) hold the view that the control of stubborn disease would depend on the use of stubborn-free propagative materials and the complete eradication of stubborn trees from nurseries and orchards. They also demonstrated the futility of planting stubborn trees and of topworking them with scions from healthy trees. As much as possible, trees should be propagated only from carefully inspected, registered parent trees, that have fruited normally, or from vigorous normal young nursery trees derived from such parent trees.

Chemotherapy of yellows diseases and other mycoplasma disease is now economically feasible. And, certain diseases of trees as well as, of some costly perenial ornamentals are being treated with chemical agents with promising results in South Africa, Japan, Europe, Asia and in several states of the United States. So far no permanent cures have been reported. However, Nyland (1974) reported remission of symptoms resulting in economic control with the citrus queening disease, peach X-disease in peach and cherry, pear decline and coconut lethal yellowing disease. Both large volume and concentrated small volume treatments may be efficacious. Nyland noted that the injection of chemotherapeutant during the dormant season may have considerable promise particularly for diseases in which the infections agent is located in the xylem. At present grabity or pressure injections of tetracycline into the outer xylem during the late growing season seems the most promising treatment for mycoplasma diseases of deciduous fruit trees. Maramorosch (1974) has also noted that many MLO and RLO diseases have been found susceptible to tetracycline treatment, but only temporary remission and no permanent cure has been obtained. Remission up to 2 years has been obtained by treating roots of Opuntia tuna monstrosa with tetracycline hydrochloride. Certain RLO diseases have been treated successfully with penicillin alone. It is also known that experimental heat therapy has provided permanent cure of a few yellows diseases.

Thirumalachar (1974) in India reported the effective control of the Greening and dieback disease of citrus caused by Spiroplasma citri with a new chemotherapeutant, BP-101. 100ppm of BP-101 was made in water and injected into the stem by drilling a hole and allowing it to be absorbed. Within 2 to 3 months, a long lasting remission of the disease was noticed. However, solubility of BP-101 is difficult and so a new formulation was made using methyl cellosolue, which is miscible with water and also acts as a surphactant. When 2ml of this formulation was added to a litre of water, a 100ppm solution was made, and on spraying the trees at intervals of 15 days for a period of 3 months (6 sprays), complete remission of the disease symptoms and heavy bearing of fruits and leaves which were completely healthy were obtained in a large orchard.

Recently also, the data of Igwegbe and Calavan (1973) show that the stubborn pathogen, like pathogens causing certain other yellows-type disease, is sensitive to tetracycline antibiotics especially achromycin and aureomycin. This discovery that some achromycin-treated stubborn plants remained symptomless for over 8 months is significant and possibly of practical importance. The suppression of stubborn symptoms is attributed to strong inhibition, or complete inactivation, of the pathogen.

It is probable that plant diseases caused by mycoplasmas and mycoplasma-like agents have been with us on earth for more than half a century. However, the impact of such diseases on the agricultural economy of the world is only recently being exploited. At present only a few diseases have been categorically classified as being incited by these agents. The nature of the casual agents and their cultural requirements demand painstaking research. As such there should be a lot of co-operation amongst agricultural personnel, farmers, industrialists and research workers in institutes and universities for the effective study of these pathogens, their incidence, natural spread , possible vectors, environmental influences, effects on yield and fruit size, susceptibility of scion and wot stock, their diagnosis and field detection, and their final control. These are major challenges to the young and budding plant pathologists.

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CASSAVA PLANT (MANIHOT ESCULENTA CRANTZ (SYNONYMOUS WITH MANIHOT UTILISSIMA POHL) MEAL PRODUCTS AND THEIR ECONOMIC IMPORTANCE IN WEST AFRICA

by

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CASSAVA AS A PLANT

Cassava belongs to the genus Manihot and the family EUPHORBIACEAE which are mainly made up of plants with latex vessels in their stems. These latex vessels secrete milky white fluids when they are pierced.

ORIGIN AND CHARACTERISTICS

North Eastern Brazil (South America) and the Central America have been suggested to be the ancestral homes of cassava (Rogers, D.J. 1963) studies of Manihot esculenta Crantz (cassava) and related species, Bull. Torry Bot., 90, 43-54. Manihot esculenta Crantz synonymous with Manihot utilissima Pohl, is a shurby, woody, short lived perenial about 3 metres tall, with erect glabons stem plant. This species is the most important of all the species of the genus, Manihot and our discussions will as much as possible be centred on this species. Other species include Manihot glaziovii (cerra rubber) Manihot abori (para rubber)

CASSAVA MEAL PRODUCTS

Meal products from cassava (Manihot esculenta (Crantz) include: garri, farinha de mandioca, wetted cassava, cassava chips and pellets, cassava flour, cassava starch and cassava flakes/pearls.

GARRI AS A CASSAVA MEAL PRODUCT

Garri is the form in which cassava is mainly eaten in West Africa. It is mainly eaten by people in the Southern part of Nigeria especially those occupying the tropical rainforest areas where the plant thrives well. Garri is low in protein, oil, ash and crude fibre but it is a valuable source of carbohydrate (35% carbohydrate-purseglove, J.W. 1968) Tropical plants diocotyledons I Longmans, Green and Co., London, 332 pp. The minerals in cassava tuber include phosphorus, iron and some amounts of calcium. The vitamins include vitamin C in relatively rich amount (35mg/100gm fresh weight); traces of niacin, vitamins A, B_1 and B_2 with negligible amounts of thiamine and riboflavin.

As a result of the above composition of garri, garri meal is usually balanced when mixed with sauce containing fair amounts of protein and vitamins. Peels of succulent cassava roots especially of B variety are

are largely used in the feeding of domestic sheeps and goats. Peels of this variety are also used for fattening cattle, horses, hogs and poultry. When fed to milk cows, it is believed to increase the flow of milk providing a rich colour in the butter fat with no ill effect to the flavour.

PROCESSING OF GARRI

The processing of garri involves peeling, grating, packing in cloth sacs or pressing, sieving, toasting or frying, separation into various size particles.

PEELING: The fresh cassava root is peeled and washed clean, then packed in trays or basins.

GRATING: In the villages, the crude effort-consuming method of rubbing the peeled tubers to and fro flattened metal sheets which have been teethed by piercing them with pointed rod ends or nails is employed. Many a time, the flattened metal sheets carry two long sticks by the sides and this serves as a means of straightening the sheets for effective rubbing.

PRESSING OR PACKING IN CLOTH SACS: This is usually done by placing the cloth sacs between three or four sticks or poles usually straight and not easily broken. After tying, the whole set up is either put flat on the ground on top of stones or other elevated objects. If flat, some stones are atimes placed on the sacs to facilitate the drying. The pressing lasts 2-4 days depending on how tightly the tying was, the humidity of the surrounding environment and the type of sac used. Pressing aids fermentation and the removal of prussic acid content of the roots liquid. Atimes oil is added into the grated roots during the packing.

SIEVING: After the pressing period, the rods or sticks are loosened and the compressed cassava mass is sieved with a sieve leaving the fibrous remains. The sieved somewhat gritty mass is packed in basins for the next process.

TOASTING: The sieved mass of cassava is finally fried in open metal pans or pots on earthen or tripod firesides under considerable heat with some drops of oil if oily products are needed or with very little oil if light products are needed or with very little oil if light products are required or white if white products are needed.

SIEVING OR SEPARATION INTO VARIOUS SIZE PARTICLES:

Atimes, the natives use various sizes of sieves to separate the final product into garri of various size particles after allowing to cool. Hence there are fine garri, coarse or fairly coarse. Garri produced in the manner could either be eaten as snack in dry form or dissolved in cold water and eaten with coconut, palm kernel or made with hot water in meal form known as "eba" and eaten with soup.

MECHANIZED GARRI PROCESSING

Mechanized processing methods have been introduced in garri processing by several factories (e.g. purcel and Williams 1973; Wadhwa 1973); NRTCB-Nigerian Root and Tuber Crops Board Ltd) etc. Mechanised processing employs grating machine which crushes the roots and then compression of the grated mass or meal is by hydraulic press machine. The compression may last for a few hours and then the garri could be ready a few other minutes later after toasting. This short method of manufacture however is not without flaws. Hence, because insufficient time is given before toasting not enough of the poisonous prussic acid fluid HCN in the roots is removed. Secondly not enough time has been allowed for the grated meal to ferment a process which has been known to further reduce the hydrocyanic acid content of the cassava root.

The local method of processing leaves only 20-30mg of prussic acid hydrocyanic acid as against the initial root content of 800 mg. Garri meal is indispensible in the daily food of the people of the Southern Nigeria. Because of the importance of this food here, dried form of cassava-garri can be stored for a long period under room temperature. The cheapness of garri, ease of storage and ease of preparation for consumption have been the qualities which gained popularity for this me l amongst the urban dwellers who have very little money and time especially the peasants, bachelors and spinsters.

FARINHA DE MANDIOCA

Farinha de mandioca is similar to garri both in preparation and method of eating. Farinha de mandioca is most common in tropical Brazil and other parts of South America. The preparation involves washing, peeling, grating sieving and then toasting in shallow basins over low fire. The major difference between garri and Farinha de mandioca is that the pressing and fermentation period in the later is much shorter but like garri it can be consumed dry, soaked with cold water made into paste with hot water or even served as salad with other meals e.g. legumes and vegetables.

RETTED AND DRIED CASSAVA MEALS

This is the most popular form in which cassava meals are made in the local areas of West Africa particularly in the South Eastern Areas of Nigeria, where the Ibos live mainly on subsistent agriculture on this cassava. The cassava root tubers are either peeled or soaked with the peels in water for several days. The soaked roots take on the average 4-7 days to soften depending on the species of cassava and the ability of the person processing the meal to keep to the rules of preparation. For instance large roots have to be reduced to smaller sizes and if the roots are steeped into water at home,water has to be changed at least daily and should be kept in secluded areas. Roots must be completely covered with water. Normally these roots are soaked in clay pots and are covered at least to avoid the entry of foreign bodies including rainwater in rainy seasons. Again, once soaked, dipping of hands into it has proved a hinderance to normal fermentation or softening and atimes prolonged the period. For instance the fermentation may be prolonged to up to 2 days or more. It can also be completely stopped. The chemistry behind this behaviour is not quite clear but in areas of Eastern Nigeria where I have conducted some interview with local populace they have confirmed this characteristics which they said leads to their drying the roots which have refused to ferment or soften after the normal ii periods in the sun. The dried roots are later ground into flour, made into paste again when needed and cooked just in the same way as retted cassava meal.

Soaking in streams also occurs where the people live near streams or have streams. The above is easier and produces better products which are odourless. In cases of soaking at home where water is a problem it is not possible to change the water daily at least and this leads to the final product possessing an offensive odour when the meal is made. Also much of the poisonous prussic acid hydrocyanic acid is not removed and this leads to serious pollutions of the bodies of those who eat this retted meals and even retards growth.
When completely retted, the roots are then made into pulp by dissolving the softened roots into specially prepared sieving baskets which are put into open basins containing water. The starchy pulp settles in the basins and could be immediately pressed and put into pots and cooked before it is eaten. Alternatively it can be left in baskets so that water could drip through and pulp collected later. The period of settling depends on the nature of cassava. For instance fully mature ones take between 1-2 days to drip completely. The meal of retted cassava is usually rolled into large balls, boiled in water, pounded, rolled again and pounded. Then it is eaten in much the same way as pounded yam or garri. In Igbo the retted cassava meal is called "Akpu".

CASSAVA CHIPS AND PELLETS

In South Eastern parts of Nigeria, cassava chips are very popular as a form of human food. Here the fresh cassava roots are peeled, boiled in water sliced into small rectangular slices or longitudinal pieces (chips) with knives or specially prepared metal sheets (curved but suitably shaped to provide somewhat flat surface). The boiled slices are soaked in water for 1-2 days and chips are either consumed at this stage or may be dried in sun for several days and stored. It could be resoaked in water when needed or eaten dry. In both soaked and dry forms these chips are consumed in combination with other food like vegetables, coconut, oil, stock fish, crayfish, castor oil been slices, maize or other cereal. In this form the meal is called "Abacha" in Igbo land.

Pellets are usually made from chips. After the drying of chips they are ground and rolled into cylinderical pellets 2 cm long and 1 cm in diameter. In this form they are used for livestock feeding especially in the temperate countries. Pellets in form of cassava biscuits are also eaten by humans in parts of Eastern Nigeria where fresh cassava is peeled, grated, made into several shapes. This is eaten in combination with other foods, e.g. coconut or fish, etc.

MEAL OF CASSAVA FLOUR

The cassava flour is usually a greyish white talcum-powdery mass usually made by pounding or milling. The roots are peeled, washed and cut into large rectangular pieces. The cut pieces are sunned dry and stored as dried cassava pellets. When flour is needed, the dried pellets are sent to mill. The milled flour is then poured slowly into boiling water in pots while continuous stirring results in the formation of meal or pudding. The meal is then consumed with stew or sauce. The flour is also used in bred baking although it is not as good as wheat flour because the texture is not as powdery as wheat flour. However by mixing it with wheat flour good results are obtained as good bread or biscuits result with lower costs.

CASSAVA STARCH

Starch from cassava is highly demanded in sugar industries for production of GLUCOSE in the textile industries for cloth hardening and in confectionaries industries for sweets chocolates and cakes). As a result of the high demand for cassava starch, production has v become highly specialized and mechanised. Machines remove the outer peels leaving the inner peels which also contain some quantity of starch. In less efficient factories, the whole peel is removed leading to loss of some quantities of starch.

After peeling, the roots are washed and grated to produce a pulp or paste. By suspending the pulp in water and employing series of revolving secreens the fibres are removed leaving the starch milk pulp usually suspended in water with 0.05% SO_2 to prevent the activities of fermentation agents. Milk is passed through a sand cyclone to remove sand and other foreign particles. This is then allowed to settle in tanks. The use of centrifugal separator can also be employed. This separates water from starch and then starch dried to moisture content 10-14%. Then pulverised, dried screened and packed for use.

GROCERY TAPIOCA/FLAKES

In the confectionaries, tapioca flakes are produced by special methods. Metal sheets are smeared with oil and placed over fire. Starch is placed in these metals while by continou Stirring to prevent burning. There is clogging together and partial textrinication with product more digestible than ordinary starch. Flakes occur when thin layer of starch is spread on pans. cooking for 2 minutes and drying at 50°C to moisture content of 12%. Other forms like pearls-granulated wet starch gelatiniced and roasted for about 15 minutes on hot pans and smeared with coconut oil at 40-50°C. All these are eaten directly when required.

Also direct consumption of cassava starch-thick semi-solid paste occurs among some people of the Niger Delta West Africa.

With the above examples of food products from cassava and the employment made of it in industries, it is crystal clear that cassava is an economic crop and as such efforts should be made to encourage its production. There should be scientific research into ways of improving its species and mechanization of its production employed.

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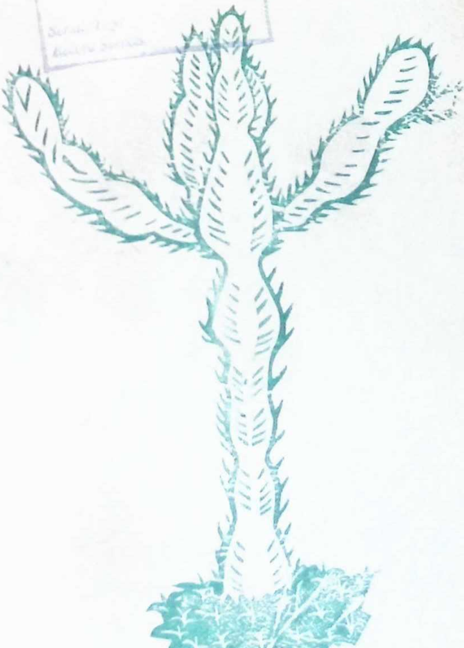
EUPHORBIA



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CONTENTS

EDITORIAL COMMENT

The fourth volume of 'Euphorbia' is again out with increased quality and volume of the articles. We have not only maintained the standard of the last issue but greatly improved on it. The criticims and suggestions recienced from various readers of the last issue have been carefully looked into and I hope that you will actually enjoy this volume.

With the international recognision accroded to the Annual Academic Journal, "EUPHORBIA", the Editorial board with the help of the Editorial Board Advisers and other members of the academic staff of the department, has made sure that all the articles published in this volume are carefully and scientifically written. I thus assure you that you will gain a lot in this present issue.

I must sieze this opportunity to express my profound gratitude to the Ag. Head of Department Dr P.G. Abraham who is also an Editorial Board Adviser, and other Editorial Board Advisers, Dr C.O. Akueshi (on Sabbatical leave) K.J. Osaji and other members of the academic staff of the department, whose untiring efforts contributed much to the successful publication of this volume.

My gratitude also goes to members of the Editoral Board and other members of the Botanical Society who stood by me day and night, despite tightened academic programmes, to see to the success of the publication of this issue. Special thanks also go to Mr Akpan I.U for his hearty co-operation each time he was called to advise and give suggestions.

I am indepted to all the companies who advertised in this issue for the financial support. Mr Jack Tilley Gyado, the life Patron of this Society Command a special thanks for his keen interest and ever ready atitude to help the sotiety both financially and morally. He is indeed a charismatic, respectable gentleman and a Philanthropist. Long life is what I wish you Mr J.T. Gyado.

I take this opportunity to wish all the best to Dr. C.M. Yaqub, who will be leaving the department of Botany at the end of March, 1981. He has rendered valuable services as the Ag. Head of Department. I hope and pray that he will have a very fruitful period ahead.

I also welcome and congratulate our present Ag. Head of Department Dr. P.G. Abraham. Before his appointment as the Ag. Head of Department he has been giving hearty co-operation and untiring effort to see for the smooth running of the Botanical Society in particular and Botany Department at large. I then hope that with his new post, much improvement will be made in the department.

In conclusion, it gives me considerable pleasure to thank those who submitted articles included in this issue. To our readers I wish you happy reading and welcome suggestions aimed at improving the quality and standard of subsequent volumes.

Thanks and good luck

OGBONNA JAMES CHUKWUMA
(Editor in Chief)

GRAND PATRON'S MESSAGE

DR. P.C. ABRAHAM
AG. HEAD OF BOTANY DEPARTMENT

It gives me great pleasure in sending this message to the Botanical Society of the University of Jos. I have added pleasure to note that this message will find its place in the fourth issue of our internationally recognised journal '<u>Euphorbia</u>'.

I am glad to realise that the Jos University Botanical Society has had many unique achievements in the past. On of the many 'firsts' of this Botanical Society is the idea of launching a National Botanical Convention for Nigerian Universities, and this is sprouted in the fertile soil of this Natural Science Faculty. Similarly today we are forming an Alumi Association for the Botany Department of this University.

Let me also take is opportunity to remind you of the call made on this stage, one year back, by our life Patron Mr. Jack Tilley Gyado to initiate the development of a National Botanical Garden in Jos. He has generously promised all possible help for its realisation. Let this be a new challenging project for us to persue. I am sure that the University of Jos and our Faculty of Natural Science in particular will also render the necessary support towards this venture.

I am fully aware that the progress of our Botanical Society is only due to the spirit of co-operation, dedication and discipline of its members. At this juncture, I would like to emphasize that education is a life long process and it need not be confined to the four walls of a class room. Co-curricular activities of this sort will help us to become better Botanists and promising citizens.

I do realize that the features in this issue of "<u>Euphorbia</u>" are of good academic standard and that it will be of immense value to the budding botanists of this Country.

Let me conclude this message by wishing this Botanical Society and its members every success. Let the Botanical Society and our Botany Department grow develop

FROM THE PRESIDENT'S DESK

I consider it to be a pleasure that I convey to you this presidential message in the volume IV issue of our Annual Journal "EUPHORBIA". This journal is not only being published to communicate to the society and the entire public the study of Botany as a course, but its roles and the contributions to the success of the Green Revolution. It is a course that interacts with other fields of studies like Zoology, Geography, Geology, Mathematics, Chemistry to mention but a few.

Since the inception of the publication of this journal, the Society has been accummulating fames and recognision in every corner of its environs and today it has gone beyond the horizon of the academic association, not only in University of Jos, but also in other universities. What can a society achieve more than to be an exemplary to other societies. To add more feather to its cap, this year's celebration hopes to witness the inauguration of its students Alumiuni, the first of its kind in this university.

The sense of duty, maturity and understanding which the members of the society have continued to display have not only gone far as unifying them, but have continued to make them worth while respectable persons in no small measure amongst the general students body both within and outside University of Jos. I hope they will not fall below this standard but will continue to play their active roles in the students activities wisely.

The cordial relationship between students and staff has been most encouraging. This will continue to inspire the students to have sense of belonging in the department. This cordiality and understanding have been further strengthened by our able and fatherly loving lecturers who understand us and our problems more than we think we do. Our Head of Department, Dr P.G. Abraham often than not garthers us together to share in our problems and to find right solutions to them. I must mot forget too, our dear Dr. C.M. Yaqub, a dedicated former Head of the Department, who did every thing within his reach to maintain the academic standard of the Department during the tenure of his office. His contributions as a Grand Patron to make the society what it is today will continue to be fresh in our memories. My greatest thanks, therefore, go to him.

I appeal to all students of the society to work harder still so that no stone is left unturned to attain the society's objectives. It is worth while to note that social and academic lives are twins that are inseparable. Therefore to do injustice to one is to forgo the other.

The Society has been making every effort to see that every session the members do no end their studies of Botany in the lecture and laboratory rooms alone. As a result, and as part of the academic programme, we have been visiting many research centres, Industries and other interesting places to acquire more knowledge that compliment and blend us for future demand by the public.

The status of the Society as it is today was not achieved over night. Its monlding and scrulpturing started somewhere and have gone through hands before it got to this stage. Therefore, I wish to extend my sincere thanks and congratulations to my predecessors, expecially to MR. CLETUS CHIJIOKE ONYEBUCHI for his dynamic leadership, the dignity, good financial stand, moral and otherwise of the society he maintained; regardless of the odds that confronted him at one time or the other. I wish him success in his academic pursuits.

My special thanks go to the Head of Department, Dr P.G Abraham for his firm support behind us. To our HONORARY LIFE PATRON, Mr. Jack Tilley Gyado, I extend my heart felt thanks for his shower of support - moraly, financially, and his keen interest in the affairs of the society. May he reap the fruits of his hard labour hundred folds. I wish to thank also my executives for their much devoted efforts and co-operation to make this celebration a meaningful one. I must congratulate the Editorial Board and its Advisers for the job well done. This is quite incredible; despite the poor financial stand, lack of time, and other inevitable problems they faced they came out with such an unbeatable academic piece of job - the volume IV of "EUPHORBIA". I say, cheers, to those who in one way or the other contributed to the successful publication of this journals.

Our special thanks are to all members of the staff who helped in all possible ways.

To the new students, congratulation for being able to join with us in the Department. We are happy to have you. For sure, if you work hard, the sky is the limit for you in the Department. There is no other way to achieve success except through hardwork, friendliness and dutifuliness. Your good contributions to the continued existence of this Society is highly needed, therefore, try to participate and co-operate. I wish you all the best of success in your academic drive in University of Jos.

At this juncture, I wish to appeal to all our final year students to contimue to work hard. The time left is shorter than the time already spent, therefore, relax not till the aims are achieved. Best wishes in your forth coming degree examinations.

Our dear readers, here it is again, the "EUPHORBIA" the fourth issue of the widely recognised and accepted Journal which poses no problem to you to digest every bit of the academic and Scientific knowledge in it. No knowledge is ever wasted. Read to your satisfaction and acquire knowledge from "EUPHORBIA".

Thanks to all our well wishers. LONG LIVE THE BOTANICAL SOCIETY - UNIVERSITY OF JOS.

APEJI OJO JOHN
PRESIDENT
1980/81 SESSION.

PRINCIPLES OF BIOLOGICAL QUANTITATIVE ESTIMATION IN SOLUTIONS

by

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INTRODUCTION:

In the far past, biology students were more or less concerned with descriptive approach to the study of the subject rather than investigational. In the recent past however, there has been a shift from mere memorization of facts to the understanding of principles. Often times, investigations require the use of instruments and equipment. If results are to be meaningful and reproduceable, it is very desirable that the worker understands not only the principles underlying the workability of designed systems but as well as those responsible for the operational functions of instruments and equipment employed in such analyses.

This treatise is devoted to the fundamental principle underlying spectro-photometric and colorimetric assays as employed in biological situations.

USES:

It is relevant to enumerate the very many uses of this class of instruments being considered before we go on and consider their working principles.

Uses of spectrophotometers and colorimeters have in the recent past been quite extensively employed in research, quality control, and routine clinical applications. Specific examples of applications are afforded:

1 AMOUNT OF PROTOPLASM ESTIMATION:

Routinely, it is important to determine the amount of phosphorus and other elements such as nitrogen, sulphur and calcium in biological materials as a basis for the estimation of protoplasm quantity in general, or specific compounds in particular.

2. ABSORPTION SPECTRA OF PHOTOCHLOROPHYLL & CHLOROPHYLL A

Transformations of chlonphyll to chlorophyll A may be observed by following the change in the absorption epectrum of an etiolated leaf, for example, on exposure to light. This analysis is no doubt, of extreme importance in photoperiodism and other physiological studies focused on the photosynthetic organ(s) of plants.

3. QUANTITATIVE DETERMINATION OF SUGAR:

Routinely, fuantetative estimations of sugars are carried out using the unknowns in conjuction with is by using ultraviolet spectrophotometry. In the former method, the absorbance of the standards. Another method of quantifying sugars at specific wave lengths is plotted againsts series of concentrations and the unknown read off. the latter method requires treating the material being analysed with Conc. H_2SO_4 before the absorption maxima at specific wavelengths are determined. In all cases the relation of absorbance to concentration follows Beer-Lambert's law which is the fundamental law forming the core principle of usuch biological determinations. This law is thus expressed:

For a given solution the absorbance of a beam of light passing through that solution is directly proportional to the concentration of the solution and also proportional to the thickness of the path. Before we expatiate on this law it is appropriate that we understand very well the effect of light on certain atomic groupings called chromophores.

MOLECULAR BASIS AND THEORETICAL CONSIDERATIONS OF LIGHT ABSORPTION:

As met with in the principles of dye Chemistry, the colour which any coloured solutions may confer is entirely dependent upon the type of chromophores present in that solution. Chromophores are chemical groups which absorb light. They are mostly found in unsaturated organic compounds i.e compounds in which double bounds exist.

Thus a solution is coloured because it absorbs specific qualities of light while allowing other colours to be transmitted or reflected. Works by Beer in this field led to what we now know and call Beer's law which is expressed:

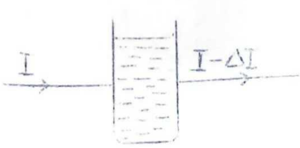
> "The proportion of light absorbed is dependent on the concentration of the absorbing substance"

While this is generally accepted and forms the basis of colorimetric and spectrophotometric analysis it is to be stated that this may not always be true. For example, if the molecules interfere with each other the amount of light transmitted or reflected is correspondingly affected. In general, energy that is absorbed by the solution increases the energy of each atom of the solution and, if the solution is absorbing U.V. radiation for example, the absorbed energy will cause some electrons to assume a higher energy state. The atom has thus acquired energy and is referred to as being excited. But this excitation is temporary as atoms in solution do not continue to absorb energy without releasing some. This released energy will appear in many forms but usually as heat and fluorecence. Most absorbing systems do release heat as the electrons fall back into more stable position. But in the instruments being described the measure at the display is in effect a measure of light passing through the solution and strictly not a measure of heat released.

The Lambert's law is equally important. This states: "Each successive layer of the medium of equal thickness absorbs an equal FRACTION of the radiation incident upon it. This fraction is independent of the intensity of the incident radiation"

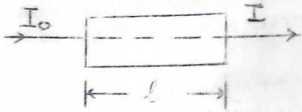
<u>THE BEER - LAMBERT'S LAW</u>:

Consider the following:



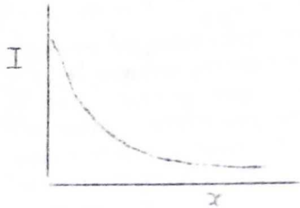
$\frac{\Delta I}{I}$ = K = a constant for a given concentration, wavelength, and thickness (ℓ)

This means that the "intensity of light ray in a medium decreases exponentially with distance".



I_o = Intensity of the incident light

I = Intensity at a distance x



Where x = distance through material

Thus, $A = e\,C\,\ell$ where A = Absorb

e = extinction coeffecient of material

C = Concentration

ℓ = thickness of path

For a given path length x we have

Absorbance (A) or Optical Density (D) or Extinction (E) $= \log_{10} \frac{I_o}{I}$

Thus the proportion of light absorbed is dependent on the concentration of the absorbing substance.

Finally, the accuracy of these instruments and their ability to give consistent and repeatable results depend very much on careful and proper operations a most important aspect being the clealiness of the optical system particularly the cuvettes.

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PHOTO SENSITIVE PIGMENTS SYSTEMS AND THEIR EFFECT IN DIFFERENT PLANT GROUPS:

BY

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INTRODUCTION:

Light is the energy source on which plants and ultimately all living things depend. It has a profound effect on the growth and development of plants. It affects photosynthesis, the synthesis of chlorophyll, germination, phototrophic movements, stem and root elongation, the opening of stomata and flowering. Kendrick and Frankland (1976). The various formative effects of light are collectively referred to as photomorphogenesis, and all these processes are directly or indirectly connected with growth, development, and differentiation of a plant, independent of photosynthesis.

Research on the photomorphogenic effects of light aims to discover and to describe in physio- chemical terms the causalities governing the process from primary photochemical reaction all the way through to the morphological - anatomical manifestation. In recent years, fascinating advances have been made in the field of photomorphogenesis - the result mainly of brilliant new ideas (for example those in S.B. Hendricks and H.A. Borthwick) are to fundamental improvements in experimental procedures.

The function of light mechanism in controlling the photoreversibly photochromic pigments in plants in order to bring about growth and development requires three steps. It must be perceived by a pigment, these must be a mechanism whereby the plant reacts to the stimulus and some degree of permenence must be achieved during which reaction to the stimulus can take place.

The pigments involved in important photobiochemical reaction but less known by non-specialists, are the photoreversible photochromic pigments. They are changed from one form to another by one kind of light ranging from (ulraviolet, violet, blue, green, yellow, orange, red, far-red to uifra-red light) and revert back to the original form by light of another wavelength composition. The most studied of these photoreversible pigments is the phytochrome.

PHYTOCHROME:

Phytochrome is a photoreversible proteinaceous pigment which can exist in two principal absorbing forms. One of which is the red absorbing (Pr) and the other far-red absorbing (Pfr). In the red light, the pigment is converted from the red absorbing form (Pr) to the far-red absorbing form (Pfr). When the far-red absorbing form is exposed to far red light, it is converted back into red absorbing form (Pr).

$$(Pr)\ 660m\mu \underset{\text{far-red light}}{\overset{\text{red light}}{\rightleftharpoons}} (Pfr)\ 730m\mu$$

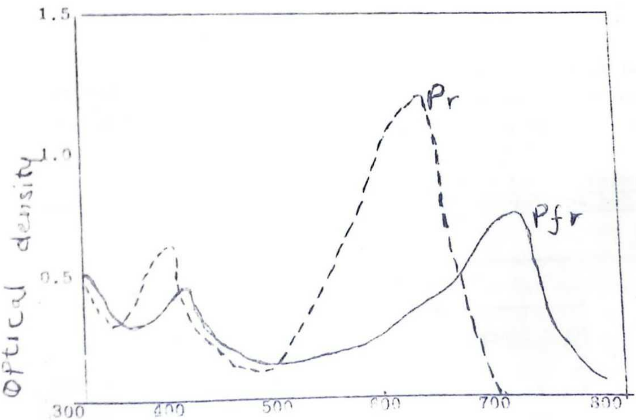
Far-red light mean radiation wave-lengths between 700 and 800 mμ. Bjorn (1979). The term phytochrome is used today as suggested by the Beltsville group of U.S. Department of Agriculture, Marland, to signify the system of photomorphogenesis which has been most thoroughly investigated and which is common to all potentially green plants. This pigment system is of foundamental importance. It is a soluble chromoprotein that is present in the cytoplasm, and which by suitable procedure can be isolated from the cell and brough into Watesy solution. Butler et al (1959).

Phytochrome appear to be involved in a wide variety of responses. The criteria for a phytochrome controlled response is that it is turn on and off or affected in opposite directions by alternating flashes of red and far-red light. This response are also affected by blue and ultraviolet light.

The non-irradiated, dark-grow plant contains almost entirely (Pr), which is stable in the dark. Pr whose maximum obsorption is around 660mμ is converted by exposure to red light into Pfr, which absorbs predominantly in the far-red with a peak mean of 730mμ. Conversely, Pfr can be reconverted into pr by exposure to far-red light. The absorption spectra of Pr and Pfr forms of extracted phytochrome was domonstrated by Butter et al (1964) as shown in Fig.I. In numerous biological processes (Pfr) show a physiologically active form of the phytochrome system. The quantum effeciency for the conversion Pr-Pfr is three times as great as that of Pfr-Pr. At higher temperature the protein is denatured and the photochemical is destroyed.

FIG. I

Absorption Spectra of Pr and Pfr of Extracted Phytochrome. After Hartmann (1966), Based on Experimental date of Butler et al (1964:



Wavelength (mμ)

Besides flowering, phytochrome is involved in many other rhemonena such as growth, stem elongation, germination, the orientation of leaves and stems to the direction of light, sleep movements of leaves, and the orientation of chloroplasts within leaves or cells.

Phytochrome and seed Germination:

The fact that promotion and inhibition of germination by red and far-red irradiation is reversible was first discovered by Borthwick et al (1952). They found that red light promotion of lettuced seed germination can be reversed if far red irradiation immediately follows, red light treatment. If seeds are again treated with red light germination will again be promoted.

The system is repeatedly reversible the last treatment determine, the response of the seeds. This is demonstrated in table one. This experiment by Borthwick et al (1952) was further supported by Toole et al (1955) and Me'lemore and Hansbrough (1969).

They concluded that germination, is promoted by red light not by blue or far-red. Hendrick et al (1960) also found out that far-red light prolonged dormancy and this effect is reversed by red light.

Germination of Lettwce seed Following Consecutive Exposure to Red and far-red light, from Borthwick et al (1952).

Treatment	Germination %
Dark Control	8.5
R	98.0
R – FR	54.0
R – FR – R	100.0
R – FR – R – FR	43.0
R – FR – R – FR – R	99.0
R – FR – R – FR – R – FR	54.00
R – FR – R – FR – R – FR – R	83.0

Phytochrome and Photoperiodism:

The action spectrum for light interruption of dark period in both short and long-day plants shows a broad peak in the red at 660mμ and the effect of this red light are reversed by far-red light which has a peak at 730mμ.

If a long night of photo induction cycle of a short-day plant e.g. xanthium is broken by a brief flash of light, the plant does not flower. The most efficient wavelength for inhibition of flowering is found at a peak of 620mμ, this inhibitory effect can be reversed by far-red light irradiation.

Also Frederick (1964) studied that in pharbitis nil (SDP), brief irradiation with Red light at the beginning of dark period would be promotive if the preceding light period is very short, but inhibitory if the light period is long or if given around the middle of the dark period would be promotive in SDP if the preceding light be expected to result from brief far-red irradiation at the same time.

In LDP, the inhibitory action of red light around the end of the photophase is supposedly due to increased and supra-optimal pfr for this phase, and flowering will either fail completely or, if the period extends well into photophase, be sub-optimal. White light or mixture of Red and far-red light which have been found favourable at this time, give an intermediate level of Pfr. On the other hand, Red light given as a night break in the middle of photophase will promote flowering, and far-red light alone inhibite flowering by virtue of its ability to remove Pfr which will remain low in darkness, but it will enhance the response to a subsequent red light treatment, Heide (1976).

The alternating effects of red and far-red radiation on the plant system had been summed up by Borthwick et al (1956). It appears that an exposure to white light during the days the Pfr form of phytochrome is accummulated in the plant.

This form of the pigment is inhibitory to flowering in long-day plants. At the on set of dark-period, Pfr is subjected to thermal and spontaneous decay, creating the Pr forms of phytochrome which is stimulatory to flowering in short day plants and inhibitory to flowering in long-day plants. The interruption of the dark period with red light will return the accumulating Pr phytochrome to the Pfr form, thus inhibiting flowering in short-day plants.

The age or amount of development which a plant must attain before it is ripe to flower varies markedly with species, Some plants such as pharbitis nil and <u>chenopodium</u> <u>rubrum</u> can be induced to flower in the seedling stage, Others such as <u>xanthium</u> <u>strumarium</u> and <u>Hyoscynamus</u> <u>niger</u> must be a few weeks of age, and some trees must be several years old before they can be induced to flower.

Species also differ markedly with respect to the number of photo inductive cycles required for flowering. Some very sensitive species, such as <u>xanthium</u> <u>strumarium</u> <u>lolium temulentum</u>, and <u>pharbitis</u> <u>nil</u> will respond to a simple photo inductive cycle. Others require several cycles and for maximum affectiveness, in the case of short day plants, the cycle must be consecutive to be maximally effective.

In those species which respond to a single photo inductive cycle, as in other species, the response increases as the numbers of cycles increases, up to some maximum number.

The leaves (or modified leaves such as cotyledous) are the organs of the plant that perceive the photoperiodic stimulus. There is abundant evidence, that in at least some plants a specific flowering hormone (florigen or anthesian) is produced in the photo induced leaf and is translocated via the phloem to the bud, where it evokes differentiation of a vegetative meristem into a floral (or inflorescence) primordium.

Current evident indicates that circadian rhythms play a fundamental role in governing the flowering response in angiosperms generally, photoperiodic control appears to be superimposed upon this basic timing mechanism in the photoperidically sensitive species. Thus the nature of the control of flowering appears to reside in a complex interaction between the phytochrome system and circadian rhythms.

Phtochrome and other Photomorphogenesis:

Farr and Elliot (1975) studied the effect of blue and red light on coleoptile and leaf elongation of corn seedlings. The red light inhibited elongation of coleoptile and leaf, but this effect was reversed by far-red light. In the dark-grown control, blue light inhibited elongation.

Deutch and Deutch (1971) studies the effect of blue light on unfolding barley leaf. They found out that low energy blue light has been found to induce unfloding of etiolated barley leaves. This induction can be reversed by far-red light. Barley leaf unfolding is normally stimulated by red lights and reverse by far-red light. Lecharmy and Jacquers (1979) also observed that internode and shoot system growth ultraviolet light 305mμ and inhibited by blue light 410mμ. When both kinds of radiation are applied sequentially, subsequent development is determined by the last irradiation. Lukens (1965) found that blue-light 450mμ inhibition sporulation in *Alternaria solani* could be overcome by subsequent exposure to red light.

Phycochromes: Green/Red Antagonism in Blue-Green Algae:

Many photoresponses in blue green algae exibit red-green antagonism in a way suggesting regulation by photo-reversibly photochromic pigment having a green-absorbing and a red absorbing form. The phenomenon that has been investigated in greatest detail is ihe chromatic adaptation, particularly the regulation of phycoerythrin formation, In some blue green algae, phycoerythrin is formed only some time after stimulation with green light while red light following the green more or less completely suppress phycoerythrin formation, Ohki and Fugita (1978).

Green and red light also seem able to reversibly switch blue-green algae between different cells forms with widely differing growth rates, morphology and some times mobility. If the algae are grown heterotrophically, short irridiation with red light suffice to put the algae in an active(rapidly growing, and in nostoc, motile) state for a long time, while short irradiations with green light switch the algae to the inactive state. This is noticeable both Fremyell (Diak off and Scheibe, 1975) which exhibits a pronounced chromatic adaptation, and in nostoc species with more constant pigmentation Laroroff (1973). The photoreversible photochromic regulator is a phycobiliprotein.

'O' Kelleychrome: Blue/Yellow Antagonism in Green Algae:

O'Kelley et al (1977) demonstrated that cell division in the green algae is inhibited by blue lights and that the inhibition can be partly overcome with yellow light. The action maximum for inhibition is at about 430mμ and for promotion is at 589mμ. They found out the photoreversibly photochromic regulator as being flavoprotein/copper protein complex.

Conclusion:

From the above discusion, it could be known that different type of plants have different form of photoreversibly photochromic regulator pigments. These pigments absorb different wavelength of light which may promote or inhibit growth and development of the plant.

In the phytochrome pigment which controls nearly all the photobiological process in all green plants, it absorbs both red and far-red light, and at times blue, violet light.

In fungi, the pigment involves is the mycochrome which absorbs, the ultraviolet and blue light, phytochrome is also noticed here.

In Algae, phytochrome, phycochrome and O'kellechrome pigments are involve depedning on the type of algae. All this form of absorbing lights lead to different type of growth, and developmental responses in plants.

MYCOCHROME PIGMENT ULTRAVIOLE/BLUE ANTAGONISM IN FUNGI:

The effect of phytochrome is also observed in fungi. Valadon et al (1979) demonstrated that phytochrome mediated carteroid Synthesis in fungus. In this case red light increase carotenogenesi in fungi and is reversed by for red light.

Recent findings disclose, that the pigment present in fungi is called mycochrome. In this pigment the reversibility of ultra-violet and blue light is involve and only short ware - length visible light ranging from 400my to 550my are effective. Bjornsso (1956).

In fungi the effective photo receptor is a flavopnoteci fung show a great number of different photoresponses such as formation of pigment (Caroteroids), germination of spores, growth of mycelia, formation of conidia. Sclorotia, and spores etc. All these respon depend on ultraviolet and blue light reversibility. Cantino and Itorenstein (1956).

Kumagis (1978) studied that Conidial development is promoted by ultravlolet light 305 my and inhibited by ble light 410m.

When both kinds of radiation are applied sequentially, subsequent development is determined by the last irradiation. Lukens (1965) found that blue light 450my inhibition of sporulation in <u>Alternaria solani</u> could be over come by Subsequent exposure to red light.

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BIOLOGICAL PROPERTIES OF KINETIN

by

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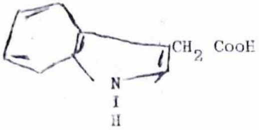
Kinetin is one of the substances known as homones. A hormone is an organic compound produced naturally in higher plants controlling physiological functions of the plant at a site remote from the site of it's production. However, are usually effective in minute amount.

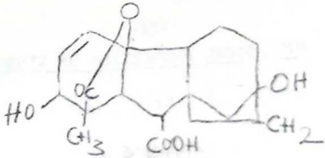
The first hormone discovered is IAA which belong to the group of Auxins. It was isolated from urine of an eighteen year old boy in 1931 by Koge and later from corn malt by the same person. It was shown to be produced at the tip of the plant by Professor Went through experiments on phototropism i.e bending of plant towards light. The chemical structure of IAA is as follows:



IAA. (Indole-3-acetic acid)

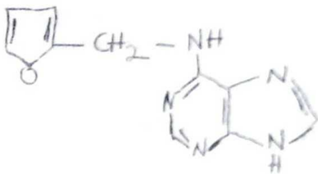
IAA has effects on cell expansion, cell division, cell differention, apical dominace, and some other metabolisms in the plant.

The next hormone discovered was aibberrellic acid 3 (GA_3) belonging to the group of Gibberellens. It was discovered from a culture of fungus Giberella fujikurai. Kurosowa in Japan observed exsessive growing on rice seedlings. He found out that the exsessive growth is due to the above fungus. In 1938, Jabuta & Sumuki isolated GA_3 from the above fungus in the form of a crystalline structure. It's chemical structure is.



GA_3 was shown to be a natural constituent of flowering plants. It has effect on cell division cell expantion, and other physiological phenomenom in plants.

After the discoverence of Gibberellens, then came the discoverence of kinetin by Professor Skoog from natural sources. It was discovered from degraded DNA of herring sperm. It's chemical name is 6-furfuryamine-purine. It's chemical structure is as follows:



A number of related purines have the activities as kinetin with respect to the plant, so skoog group them under the name cytokinins from the word cytokinesis.

Cytokinins stimulate cytokinesis, i.e the division of one cell in to two danguter cells in nemy tissue culture, when present in low concentration and in presence of IAA. They are necessary for the correlated behaviour of mitosis and DNA synthesis. They induced cytokinesis due to the ability to stimulate DNA synthesis.

Cytokinins influence enlargement phase of growth in plants. They promote elongation of stems and petioles of bean seedlings. On the other hand, they inhibit the elongation of segments of pea stems if they are applied at a high concentration. Their effect on elongation in plant depend on the type of plant and concentration applied.

Skoog using isolated plug of tabacco pith showed that both kinetin and anxin are essential for the formation of a growing tissue cultune . He also showed that their relative concentration have determinatine effect on the cultures especially in their capacity to initiate root and shoot meristems.

When leaves of plants floats on water for a few days they use their chlorophyll and become yellow. But when kinetin is present at low concentration in the water, the leaves retain their chlorophll much longer. In other words, kinetin delays the on set of senescene in the leaves and in general it have a senescene-delaying effect on the plant tissues.

Application of kinetin can double the amount of RNA of onion root tip cells within half an hour, thereby altering the pattern of protein synthesis. Kinetin has the ability to preserve protein in detached leaves of a number of species. This is done may be by kinetin activation of amino-acid retention by responding cells. There is evidence from electronmicroscopy that kinetin preserve polyribosome and maintain ribosome number under conditions that usually make them break down. Kinetin can also preserve nucleric acid of proteins by supresing the activity of the enzymes that degrade them e.g ribonuclease and deoxy-ribonuclease. It has also been shown that cytokinins in general are constituent of certain transfer-RNA (t-RNA) molecules.

A few cases of enhancement of flowering by treatment with cytokinins are known. For example, flower formation in _chenopodium rubrum_ has evoked by treatment with kinetin under long days. Contrarily, _Arabidopsis thalina_ can be brought to bloom under short day treatment with kinetin.

Growth regions in plant turn soluble nitrógen compounds in to protein. Kinetin help in this process by mobilizing the soluble nitrogen compounds in the plant so that they reach the growth regions of the plant. This is demonstrated by the experiment carried out by Motines and Engelbrecht. They applied kinetin on a part of a leaf and a ^{14}C-labeled (cardon 14) nitrogenous substrate (such as glycine) at another part of the same leaf.

They observed that the kinetin caused the nitrogenous substance to be mobilized against concentration gradient towards the kinetin drop and concentrate there. They concluded that localized apllication of hormones may regulate redistribution and metabolism of the nitrogenous solutions in the plant cells.

When seeds of certain plants are planted they take along time before they germinate. This period of sleeping is called dormancy period. When the seeds are soaked in kinetin before planting the domancy period is not observed. So, we conclude that kinetin has the ability to break domancy of seeds.

Kinetin has the ability to initiate bud formation in tissue culture. But this ability depends on the presence of IAA in the culture. In presence of high IAA concentration root initiation is favoured while in presence of high kinetin concentration bud initiation is favoured.

In spite of detail report on the properties of kinetin and other hormones in general, their mechanism of action is not yet known with certainty. Their mechanism of action in presence of other hormones are also not known exactly, although some light has been thrown in the area recently. But there is still alot to be learnt and this is a challenge to scientists and it also provided an area for further researches to be carried out.

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ENDEMICS AND THEIR TAXONOMY

BY

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INTRODUCTION:

In Botany the word endemic is applied to any species of plant or other taxonomic unit which is so distributed as to be confined to a particular country or region. It will therefore be seen that without further qualification the word is almost meaningless because every species is contined to some area, though that may be a very large one.

So, in the Geography of plants the use of the word is restricted somewhat conventionally to species or other units having a comparatively or abnormally restricted range (Cain, 1972).

Engler (1882) has pointed out that there are two main types of endemics. These are:

(a) the relicts or palaeoendemics, which are taxa that have survived in a limited part or area of their past territory;

(b) the socalled new, anthochthonous endemics, which have arisen by means of differential evolution in the area concerned.

Few difficulties are involved in distinguishing these two types of endemics. This is because palaeoendemics rarely have nor close relatives in the same or adjacent regions whereas neoendemics tend to have numerous, often close bonds with other species in the same or nearby regions (Wulff, 1950).

Endemism may be particularly useful in the recognition of different floristic regions and also in determining or expressing the degrees in which floras differ. For instance, it is often noticed that while one part of a large region possesses a high proportion of endemics another and adjacent region may have considerably fewer, and this is often a useful guide to the delimitation of the two.

Nevertheless, it should be noted that for endemics, whether relict or young species, there is no means of an exact delimitation of the area. Sometimes he use of the term is precise, as in the case of islands, isolated mountains, nunataks, or strongly marked habitats such as Serpentine soils or a particular salt desert; but generally speaking the limits of an area in which a species is endemic are more or less arbitrarily defined.

Endemics may therefore be said to be a species of plant or other taxonomic group with perculiar characteristics in terms of the geological history of the flora in which they exist.

FACTORS FOR ENDEMISM

There are many factors which can give rise to endemic phenomena in plants. These include - Isolation, Edaptic, and climatic and Disjunctive factors.

1 ISOLATION: Isolation can be either geographical, ecological or reproductive in nature.

(a) Geographical Isolation: In this respect, it is said that given any species in any region, its nearest related species is not likely to be found in the same region or in a remote one, but in a neighbouring district which is separated from the first by a barrier of some kind. This is because this barrier prevents free inter-breeding. Regardless of how a portion of the species happens to be on one side of the barrier away from the bulk of the species, the isolated population is subject to a different selection pressure and can develope along lines which are independent of the other portion.

Geographical isolation has occured in various places and forms but the one that affects endemism most is that which results in the formation of continental islands, Oceanic islands and Mountain barriers. Charles Darvin (1959) was one of the first botanists to become interested in the problems of insular floras. In the "Origin of Species" he brought out three basic facts:

1. that the species of all kinds which inhabit Oceanic islands are few in number compared with those in a comparable continental area;

2. that despite the selatively scanty flora, the proportion of endemics is often extremely large;

3 that the proportional numbers of the differnt orders are very different from continental areas, certain whole taxonomic groups which might be expected failing to occur.

Ridley (1930) distinguished between continental and Oceanic islands. Continental islands, he says are really "detached" fragments of continents or larger islands. They possess larger numbers of species than comparable Oceanic islands and have more species to the genus, on the average. They contain plants and animals of types for which trans-oceanic dispersal seems impossible or highly improbable. Examples are canaries, Galapagos and Cape Verde islands.

Oceanic islands are supposed never to have had any land connections from which even a part of their flora could have been derived. Their total number of species is small and genera average only a species each. The more remote such islands are, the smaller their flora. Sea-borne plants reach the remote islands in greater abundance than wind-borne plants. Examples of Oceanic islands include Ascension, St. Helena, Azores.

Mountains like Oceanic islands, have long been a focal point of interest to biogeographers. Here, evolutionary forces are contrated and focused onto a smaller number of biota in simpler communities. Environmental extremes, such as temperature, wind, radiation, rainfall and drought operate on small isolated populations of plants and animals, often with an abundance of open habitats were competition is at a minimum. This is because there same extremes of environment reduce the in flow of competitors from lower altitudes.

Under such conditions evolution is accelerated and the origin and survival of new biotypes is encouraged. Here too, the effects of genetic drift are sometimes apparent.

Also, chance survival may occur in small populations when there characters are not subject to strong selective pressures. Hence mountains provide an excellent open-air laboratory in which to study endemism.

Denton (1979) examined factors contributing to evolutionary divergence and endemism in Sedum. Section Gormania (Crassulaceae). He observed that all the twelve taxa in sedum. Section Gormania (sedum albomarginatum, S. laxum SSp flavidum, S. moranii, S. oblanceolatum, S. obtusatum SSo. obtusatum, S. Obtusatum, SSp boreal, S. obtusatum SSp paradisum, S. obtusatum SSp. retusum and S. oregonense) are geographically restricted to Western North America, occuring on a variety of rock outcrops that range in elevation from 55 to 3,700 meters.

Evolutionary divergence of the taxa was facilitated by temporal isolation of the flowering periods, cytological differentiation, and changes in the breeding systems.

(b) Ecological Isolation: Within a geopgraphical area there are a number of local habitat types that are due to the action of local topography, microclimate soil and vegetation. As a result of the mosaic-like or alternating pattern of ecological differnces, closely related species frequently occur in the same geographical area. It is a common assumption, when such species hybridize only where they meet at ecological boundaries, that they are kept apart by the spatial pattern which results from their different ecological requirements. This phenomenon approaches geographical isolation but on a smaller scale. Nesom (1978) continued the effect of eceological isolation when he studied two narrow endemics from the South Western United State. These are Erigeron hessii Nesom and Erigeron Kuschei Eastwood.

(c) Reproductive Biology:

Merton (1961, 1966) worked on African mountain species by growing them in cultivation. He observed that these species are self-compatible and in many cases self-pollinating. He also observed that few members of the montane are obligate inbreeders and most have retained an unspecialized reproductive biology. This is a valuation adaptation for species migrating into new areas.

This means that self reproductive compatibility is essential for endemics colonizing new area to survive. Some montane genera include Pennisetum, Cyperus, Salvia Aspiha, Desmodium, and Anthespermum.

2. EDAPHIC FACTORS:

The influence of soils on the kind of plants allowed to grow in a particular place is an extremely complex habitat condition. The soil itself is a system as intricate as the vegetation it suports. It provides anchorage, water and nutrients for plants. The taller the plant, the deeper the roots must penetrate the soil in order for it to have firm anchorage. This means that the depth of the soil determine the type of plants that grow on it. Also, soild texture and structure vary according to the presence of the different proportions of soil particle e.g platty, columrer, blocky and grannular structures. These combine the different proportions to determine the type of soil textures e.g. sandy, clayey or loam-soils. The different textural types have sizes of pore spaces which are important in delermining relative proportions of air and water in the soil. It is through the soil water that essential plant nutrients are made available in absorbable form for the plants while some are stored in colloidal particles of soil. Some of the essential plant nutrients are potasuim, phosphorus, calcium, nitrogen, magnesium and sulphur.

Many work have been carried out which confirm the influence edaphic factors have in determining the distribution of endemics. For instance, [illegible] (1978) studied the distribution of maritime chaparal, an endemic shrubs of the montergy Bay region of califonia. These include Arctostaphylos tomentosa, A. hookeri, A. monstereyensis A. pajaroensis, A. pumila. He discovered that maritime chaparal was best developed on deep sands though it was also locally common as the understory of closed-cone pine and cypress forests on clay-pan soils or very rocky soils.

Also, Argus and Steele (1979) studied the taxonomy and distribution of salix tyrellii, another sand dune endemic in south of lake Athabasca, Saskatchewan (Canada) and observed that it is related to salix planifolia found in Northwest territories and Manitoba (Canada). These two do not occur together because of their adaptation to different edaphic requirements.

3 CLIMATIC FACTORS:

The factors of greatest importance in this respect are those of light, temperature and humidity. They are all essential and vary in amount or intensity from one part of the biosphere to another. All of them interact with each other and operate in combination to produce those atmospheric conditions which will either permit the presence of certain plants in or exclude them from a particular habitat. The condition of any one of these factors obviously have a direct effect on that of the other.

Collinson (1977) has written that the seasonal and daily variations of solar radiation are a function of latitude and are of great biological consequence. Studies carried out on physiological activities in relation to period of illumination shows that in middle and high latitudes, most flowering plants can be classed into long-day, short-day and indifferent plants, according to whether they flower in response to critical day or night lenght. Short-day plants flower in late summer and autumn e.g. Chrysanthemium sp., while long-day plant such as Raphanius flower in the late spring or early summer.

The dependence on day lenght means that long-day plants are excluded from low latitudes and that short-day plants may be excluded from higher latitudes as they may not complete their reproductive cycle before the first killing frost arrive. The selective force of day lenght is very powerful, and within particular species there may be ecological races adapted to different day lenghts.

By comparing the climatic, topographic and adaphic atributes of area differing in frequency and kinds of endemism, stebbins and Mayer (1965) have identified these conditions that are conducive to the persistence of relict species and there most favourable to speciation. Their conclusions are as follows:

> In regions with ample moisture, as well as in regions with a marked defficiency of moisture, floras are likely to be relatively stable, and most of the endemic species are ancient or at least not recent. This is due to the fact that most of the climatic shiffs which occur during geological periods of time and which affect moisture availability will keep the climate within the range of tolerance of the resident species, and will allow them to persist in the same area with little or no change in their genetic makeup. On the other hand, in regions on the borderline between zones of adequate moisture and of defficient moisture, even small climatic shiffs will change local conditions beyond the limits of tolerance of the resident species, so that they must either migrate or evolve new ranges of tolerance. In many instances both climatic shifts and species imigration will bring together related species which previously were seperated from each other, and so will promote hybridization between differently adapted types. Hybrid swarms derived from such crossings are particularly favourable gene pools from which new adaptive gene complexes may be constructed. They further observe that in this way, climatic and edaphic diversity, occuring on ecotones or border regions between different biotic provinces are factors which most actively promote the evolution and differentiation of species of higher plants".

4. DISJUNCTIVE FACTORS:

This phenomenon of disjunction is one widely encountered in the studies of plant distribution. This may result from environmental discontiniuties such as topography, climatic, edaphic and biological.

They may depend upon the dispersal capacity of the plants.

DISTRIBUTION

It has been observed that the number of endemics vary from region to region, depending largely on the geological history and condition of the region. Their percentage occurrence also vary in this way. The condition of endemism in islands is probably best known in view of the fact that much work has been done on the islands and as stated earlier, they are much isolated and favours the processes of evolution most. For instance, Wulff (1943) gave the following list of endemic percentages for certain islands:

Islands	Percentages
Canary	45
Corsica	58
Madagascar	66
New Zealand	72
Hawaii	82
St. Helena	85

Szymkiewicz (1938) made a study of endemism in Oceanic islands of three archipelagos. These canaries, Galapagos and Hawaii. Below are his findings.

In canary island (table I) there are seven seperate islands that make up the Canaries. These islands are arranged according to their sizes. The number of species endemic to each of the islands are listed. Also listed are the number on each island that are endemic to the archipelago (the whole 7).

TABLE I

ENDEMISM IN CANARY ISLAND

		Area in Sq.K.m	Max.Altitude in M	Endemic to one Island.	Endemic to the Archipelag
1	Tenerife	1946	37115	81	233
2	Fuereventura	1722	860	11	51
3	Gran Canaria	1376	1898	57	155
4	Lamzarote	741	684	8	43
5	Palma	726	2356	16	111
6	Gomera	378	1340	17	102
7	Hieno	278	1512	7	76

DATA: From Szymkiewicz (1938).

The observation on the above table shows that both types of endemics (i.e to one island, or to the archipelago) diminish regularly with the decreasing size of the islands except for Fuereventura and lamzarote. These two exception to the otherwise stricking carelation are easily explained by the low elevation of these islands. Szymkiewicz states that the number of species evolved in a region (such as one of these islands) would depend upon the age of the land area, that is, the duration of evolution there, and the nature of the terrain, for evolution apparently depends upon its general climatic favourableness and the variety of conditions offered. In the Canaries the climate is dry at low elevations and humid in the high altitudes. As a result, it is more favourable and varied in the higher islands, and variety are offered on the larger islands. He also observed these same results on Galapagos and Hawaii-an islands.

Mountains on land are in many respects like islands in the seas, because their isolation is relatively complete for reasons outlined earlier (see geographical isolation). In continental regions and large islands it appears that as a general thing, endemism tends to be high in mountainous areas.

Many endemics among flowering plants are known from the higher southern Appalachians, and this phenomenon extends to the lower plants.

Endemism appear also to be higher, on the average, in older land, masses than in younger ones. For examnle, the lands of the Northern hemisphere which were covered by the Pleitocene ice sheets seem to be conspicuously low in endemics.

There would therefore appear to be no reason why the conclusion which Szymkiewicz reached concerning the evolution of endemics on islands cannot be applied to other isolated areas. For example, endemism in a mountain system on a continental mass should be in proportion to its relative age, its area, its general favourableness for vegeration, and its variety of conditions.

ENDEMISM IN THE WEST AFRICAN FLORA:

West Africa has a flora of some 7,500 species. It has been the subject of intensive study over the last 20 years with the preparation of the revised edition of flora of West Tropical Africa. As a result our knowledge of taxomomy, nomenclature and distribution of the vascular plants of this region is probably more complete than that of any other major region in tropical africa.

A totcal of 5,091 dicotyledons species have been recorded both from mainland West Africa and the off-shore islands of Principe, San Tome and Annobon (Hepper and Keay, 1954, 1963; Excell, 1955, 1956). Out of 5,091 species of dicotyledons, 714 (14%) are montane. Montane species are defined as those predominantly or exclusively associated with land over 750 meters high. Land of this elevation is markedly disjunct in West Africa and can be grouped into four major systems.

1, The cameroons system - i.e Cameroons mountains, Fernando Po, the Adamaoua and Mandara ranges extending inland to near Lake Chad; the Bauchi Plateau, and isolated peaks in Southern Nigeria Oban and the Idanre Hills.

2. The Togoland System - the Togoland Hills and Atakora mountains.

3. The Guinean System - including the Nimba and Loma mountains, Tingi Hills and Fouta Djalon etc

4. The Oceanic islands of Principe and San Tome.

Within the montane flora of West Africa, 47% of the species are confined to West Africa - that is they are West African endemics; 53% are species which also occur outside West Africa, mainly on the mountains of East and Central Africa, that is they are widespread species Morton (1972).

Most of the West African endemics are confined to only one of the four mountain systems descrined above. Only 15% occur on two or more systems. The Cameroons Systems is by far the richest in endemics with 48%. The Guinean system has 20%. The islans are said to have 15% and the Togoland system only 2%.

The high incidence of endemism (47%) in the mountains of West Africa is remarkable and has been said to be an indication both of the active evolution which has occured, still occuring and also of the considerable degree of isolation to which this flora has been subjected. Majority of these endemics are species of recent origin. Their close relatives are found either in the montane vegetation or the lowland forest and savannah. Several genera and families in exploiting the apportunities afforded by these mountains and islands, thereby filling the ecological miches with new species.

Excell (L.C) observed that the islands San Tome, Principe and Annobon have been isolated from the mainland since their volcanic origin during the tertiary. As a result their present flora must have arisen from chance arrivals accross the ocean from mainland africa.

This is how the islands become colonized by plants from the lowland forest and from these the endemics develope. The high proportion of forest endemics in the mountains of these islands is merely a reflection of the natural vaccuum that existed on the islands after their volcamic origin and of the forest habitat which dominates them.

In contrast to the islands, the montane forest of the mainland have not shown the same degree of speciation. This is because they have always shown a closed system which has usually been continous with the lowland forests. No ecological vacumm existed in which accelerated speciation could be favoured, as a result few montane forest endemics have evolved.

SUMMARY:

In Botany and Geography of plants, the word endemic refers to plant species or other taxonomic units which have a comparatively or obnormally restricted range. There are two types of endemics, these are, the **relicts** also known as palaeoendemics and the so called new, anthochthonous endemics also known as neoendemics.

Many factors contrinute to endemic phenomenon. Among these are; Isolation (geographical, ecological and reproductive), Edaphic, Climatic and Disjunctive factors. Distribution of endemics vary from region to region. Islands contain more endemics than mainland and mountains..

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GROWTH SUBSTANCES IN GROWTH AND DEVELOPMENT OF PLANTS:

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INTRODUCTION:

The most obvious thing plant do is to grow. The astonishing changes which occur, especially, in higher plants may pass with little comment, but when a seed grows into a mature plant, it alters remarkably in size and shape. Roots, stem and leaves appear and during maturity, organs concerned with reproduction; flowers, fruits and seeds are formed. Growth, being such a complex and active process, it is not surprising to find that the factors which contribute to its control are no less complex.

Three groups of such factors are distinguishable. The first is nutritional factor, concerned with the supply and accumulation of raw materials for the manufacture of protoplasm and cell wall. The second group is genetic factor which springs from the plants own constitution and therefore heriditory from parents. The third group is hormonal factor which controls the nature and intensity of growth in several organs of the plant.

However, there can be no sharp line of demarcation between these three categories; there is very considerable overlapping and devotailing. Thus it is quite possible for any one individual factor to have deep-seated influences on the others. Also environmental factors exert some control over plant growth. The external factors act through the internal mechanisms which control growth, just as the driver of a motor car exerts his influence only through the vehicles inbuilt controls. Attention is hereby focused on the hormonal factors and other growth substances in growth and some aspects of development of plants, with particular reference to higher plants with more complex organs.

TERMINOLOGY:

A perusal of very extensive literature reveals consideravle overlapping and ambiguities in terminology, in attempt to characterise the plant growth regulating substances. The definition of plant hormone by Fitting (1909, 1910) met with difficulties in explaining the different responses and reactions of several compounds both synthetic and natural. Pincus and Thimann (1948) defined Plant hormone as "organic substance produced naturally in higher plants controlling growth or other physiological functions at a site remote from its place of production and active in minute amounts". To distinguish it from animal hormone, it was termed phytohormone. Pincus and Thimaan (1948) defined auxin as "organic substances which promote growth (i.e irreversible increase in volume) along the longitudinal axis when applied in low concentrations to shoots of plants freed as far as practicable from their own inherent growth promoting substance. Auxins may generally do have other properties but this is critical". Plant regulator includes organic compounds other than nutrients supplying energy and essential minerals. In small amount it promotes, inhibits or otherwise modifies physiological processes in plants. Since they regulate growth they are called growth regulators, besides, there may be flowering regulators which affect flowering.

Larsen (1955a) criticizied the adoption of the term regulator" for all organic substances affecting growth and development. Audus (1959) supported him for the simple reason that to regulate growth, it would mean that the substance should work and do so regularly, this many of the so-called synthetic growth regulators do not do. According to them growth substances was a better terminology for all organic compounds which at low concentration promote, inhibit or qualitatively modify growth. Plant hormones are then substances produced by the organ itself and regulate some aspects of plant growth e.g "growth hormones","flowering hormone", "wound hormone". Auxins are growth substances affecting extension growth of cells; they may be natural ones produced by the plant itself or synthetic ones having the same action as the natural ones, but so far not detected in plants.

GROWTH SUBSTANCES:

Growth substances could be split into two major categories.

(a) The phytohormones

(b) Other Growth Regulators

(a) The Phytohormones:

There are now five classes of phytohormones namely: (1) Auxins (2) Gibberellins (GA) (3) Cytokinins (4) Inhibitors example Abscisic acid (ABA) (5) the recently included Ascorbic acid (Vitamin C) (AA). They are chemically very different from each other. They are synthesized in various parts of the plant from where they move either in a basipetal polar fashion in the xylem or phloem or both to the sight of action.

(b) Other Growth Regulators:

This covers all the synthetic hormones. (1) Synthetic auxins, e.g 1-naphthalene acetic acid (NAA), Indole propionic acid (IPA), Indole butyric acid (IBA), 2-4 dichlorophenoxy acetric acid (2,4-d), 2,4-5 trichlorophenoxyacetic acid (2,4-5t) etc.

(2) Anti-auxins e.g. Malic hydrazide, Tri-iodobenzoic acid (TIBA) etc.

(3) Growth retardants e.g. 2,4-dichlorobengyl nicotinium chloride (2,4-DNC), 4-hydraxyl 2-isopropyl-5methylphenyl trimethylammonium chloride, 1-piperidine carboxylate (AMO 1618), Phosphon D, Chlorocholine chloride (CCC). Ethylene, a gas at ordinary temperature, produced naturally by plants during metabolism is known to have effect in the breaking of dormancy and root production.

GROWTH SUBSTANCES AND THE CONTROL OF GROWTH:

What is growth? As in any organism, growth in plant consists of an irreversible increase in size which is commonly, but not necessarily, accompanied by an increase in solid or dry weight and in amount of protoplasm. Some investigators speak of growth solely with reference to the extension or growth in surface of the cell. It is, however, frequently difficult to demarcate this phase sharply.

To apply the term growth to a visible change in external dimension or volume alone appears artificial since throughout its development the cell increases in one way or another. Perhaps the most characteristics feature of organic growth is the fact that it does not occur at random; already embryonic growth is organised. In fact, the rates of cell division and planes in which they occur, the direction of cell elongation are specific in each form and are under definite control. Under normal circumstance, growth does not produce an amorphous disorganised mass of cells or formless body, hence we are able to recognise a particular organ or an organism by its typical form. How all these phenomena in growth are controlled and interrelated, poses many problems of physiological, biochemical, ecological and genetic nature.

<u>Where does growth occur?</u> The growth of a plant is not ordinarily uniform throughout the entire organism but it is concentrated in specific and characteristic growing zones called 'meristem' found at the root tips, lateral and apical buds. Also lateral growth or growth in thickness occur, especially, in perennially growing roots and stems. Cambium located between the xylem and pheloem is responsible for this. Another localised meristem is the cork cambium of phellogen. In internodes and leaf sheaths of many monocotyledonous plants, particularly, the grasses, growth is brought about by an embryonic tissue zone which is somewhat removed from the apical meristem and lies inserted between tissues which are more or less differentiated. These intercalary meristems are determinate since in time the cells lose their embryonic character. Here attention is paid to Growth substances involvement in cell elongatio and division; apical dorminance and bud dormancy; and rooting.

<u>Cell Elongation and Division</u>:

The living cell is essentially an osmotic system. The central vocuole contains a variety of dissolved substances and is separated from the surrounding protoplasm by a semi-permeable membrane. Elongation may be expressed as an increase in weight, volume or length of a tissue. Elongation under water absorption could occur where the cell wall is passively extended beyond the limit of elasticity and this irreversible stretching implies growth.

It is known that cell elongation occurs in presence of auxins if no other factor is limiting. The optimum range of concentration for cell elongation varies greatly with different tissues and relatively high concentrations usually exert an inhibiting effect upon this phase of growth. Bonner (1961) found that the response of the coleoptile section to optimal concentration of Indole-3-acetic acid (IAA) is very large, causing in some cases a tenfold increase in rate of elongation.

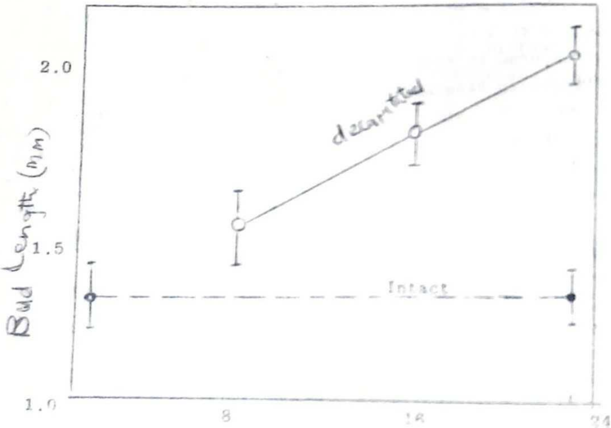
A fully grown cell divides, giving rise to new daughter cells. In meristematic cells, the nucleus may be triggered to divide, followed by cytokinesis. Cytokinins are known to have a great influence in promoting cell division. The stimulation of cell division in plant tissue cultures was the first effect of kinetin to be observed (skoog and Miller 1957). When IAA and Kinetin are applied together in the right ratio of concentrations, the results are striking and growth of culture can be maintained indefinitely. It has been suggested that the small response invoked by Kinetin or IAA used alone on tobacco pith culture was due to small amounts of endogenous kinetin-like substance and IAA already present.

Apical dorminance and bud dormancy:

The term apical dorminance refers to the inhibiting or retarding effect of terminal bud upon growth of lateral buds. The first hint that apical dorminance might be caused by auxin produced at the terminal bud and transported downwards through the stem was given as studies by stoc and Thimann (1934). Removal of the terminal bud of the broad bean and its replacement with block of agar resulted in lateral bud growth. Replacement of the terminal bud with agar block containing IAA, suppressed lateral bud growth in much the same manner as the terminal bud. In this correlative phenomenon, the apex is able to communicate a distance of many centimeters, thereby regulating the onset or rate of growth. Recent reviews by Champagnat (1965) Guern and Usciati (1972) and Phillips (1975) have discussed the still controversial state of knowledge in this field.

It has also been shown that lateral bud outgrowth occurs a few hours after decapitation of the shoot. Rubinstein and Nagao (1976) presented the following data, (redrawn from Wardlaw and Mortimer, 1970) in their review of lateral bud outgrowth and its control by the apex.

Growth of Pea lateral buds on intact or on plants decarpitated 2cm above the 4th node. (Redrawn from Wardlaw and Mortimer, 1970).



They showed that bud growth could start as soon as six to ten hours after decapitation of shoot. No bud growth was found in the intact plants with shoots.

Pea seedlings have been favourite objects for studying apical dorminance for they respond in a clear-cut manner to auxin and cytokinin aplication, they were used in studying changes in endogenous hormones in two interdependent auxillary buds during the period of deinhibition. Jablanovic and Neskovic (1977) noticed the following: decapitation of the stem in one-week old pea seedling below the first node caused on outgrowth of two cotyledonacy buds, later, one became dorminant while the other one was inhibited.

Cutting off the dorminant bud released the inhibited one. They measured the levels of endogenous auxins and cytokihins in dorminant, inhibited and released buds and found that inhibited buds contained very little acidic ether soluble auxins, a high level of tryptophan and high level of cytokinins in comparison with dorminant buds. The release of inhbition in inhibited buds caused a rise in auxin content and a decline in tryptophan and cytokinin level; and with in six days the level was same found in dorminant buds. As a powerful inhibitor of bud growth, ethylene may have controlling influence on apical dorminance. Its production is much more prevalent in meristematic tissue, where auxin is produced, a circumstance that suggests that IAA controls ethylene formation in etiolated pea stem (Burg and Burg 1966).

Bud Dromancy: The process of growth in plants is found not to be continous. Buds of stem or storage organs may show temporary suspension of growth referred to as dormancy. Wareing (1953) demonstrated that bud dormancy in woody species is a photoperiodic phenomenon, being caused by short-day lengths and relieved by long-day lengths. Hemberg (1949) first suggested that bud dormancy in wood plants is controlled by growth inhibitors produced as a result of photoperiodic stimulus. Gibberellic Acid (GA) was found to be effective in breaking bud dormancy and cold treatment needed by many buds to break dormancy is also a means of raising the level of endogenous GA. "Dormin" with identical chemical and physical property as Abscisin II (ABA) is the name given to the dormancy - inducing hormone isolated fron birch leave. IAA is regarded as exhibiting inhibitory influence to lateral bud growth (Snow, 1937). This is indirectly experienced through the high level of ABA, maintained by IAA. According to snow, the inhibitor moves into the lateral buds and prevent their growth. The known natural growth regulators that control bud dormancy are: GA, Cytokinins, ABA and IAA. Other useful chemicals apart from GA that release dormancy are ethylenechlorohydrin and thiourea.

Rooting: Although the process of lateral root induction has been studied since the early thirties, a full description of the interacting hormonal factors has got to be given. Experiments with stem cuttings show that the presence of buds on cuttings favour development of roots when the basal portion of the cutting is introduced into a suitable rooting medium. Leaves, if young also favour production of roots on cuttings. These observations suggest that root **initiation** in cuttings is favoured by hormones which are synthesized in buds and young leaves, and are translocated to the basal part of the cutting. Auxins occur abundantly in most actively growing tissue. Extractable auxin is most abundant in about 2 to 10 mm from the tip of lens root and the most active growth is about 2mm from the tip. Removal of root tip as a source of auxin showed increase in root growth. Some workers failed to obtain such results in decapitated root tips. This created considerable doubt about the role that auxin might play in stimulating root growth.

Both cytokinin and ABA, which are present in the root tip and inhibit lateral root primordia (LRP) formation in cultured roots, have been suggested as possible candidates for the inhibitory role of root tip on the emergence phase of lateral root growth (Torrey, 1962). Wightman et al (1980) found the following: all auxins he used promoted the initiation of lateral root premordia and all but 3-indolypropionic acid inhibited the elongation of the resulting lateral roots. All cytokinins at 10^{-6} m concentration and above inhibited both initiation and emergence of lateral roots. ABA and xanthoxin inhibited both emergence and elongation. Applying auxin and cytokinin on decapitated and disbudded pea cuttings from the top, Mohammed (1980) found that different stages of the root initiation phase require different levels of auxin and cytokinin. In suitable concentrations, some gibberellins favour root elongation in some species. But the formation of roots on cuttings is inhibited by treatment with gibberellins. Eliasson (1980) found that irradiation of base internode of stem cuttings of Pisum sativum L with white light during rooting period resulted in the formation of fewer roots.

Growth Substances and the Control of Development:

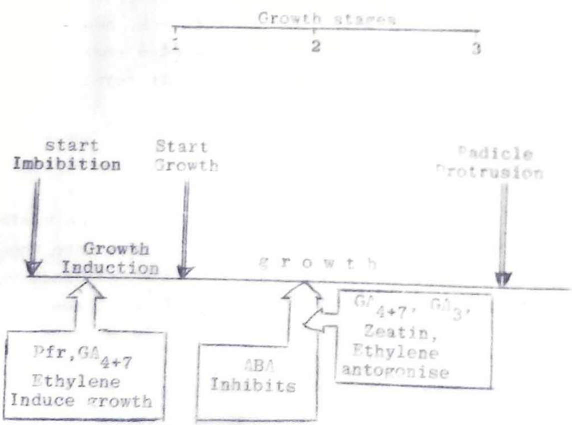
What is development? It is a qualitative concept referring to obvious morphological changes that accompany growth. It is however, difficult to draw a sharp line between growth and development; the two processes commonly go hand in hand and occur simultaneously in the same individual organ or organism. We may better understand the distinction if we consider that growth is measurable with a ruler or balance, whereas development is most commonly assessed by qualitative observation. Development and differentiation depend on variation in the effective action of set of genes, growth hormones, environmental factors etc.

Some aspects of development: Aspects of development examined in this article are germination and flowering.

Germination: It is a process by which the dormant embryo wakes up, grows out of the seed coat and establishes itself as a seedling. It is pertinent to ask: how is germination induced and how can phytohormones engage in individual stages of germination? Before germination begins, barriers to germination (dormancy) must be removed and necessary conditions for germination (water, oxygen, temperature and light) given; then mobilization and translocation of broken down sugars to the embryo as energy source could occur. Van Overbeck (1968) working on barley grains, provided the answer thus: Water uptake into the embryo activates the synthesis of mRNA and GA is discharged into the aleuron layer, where the synthesis of three hydrolases occurs. α-amylase passes into the endosperm and degrades the starch. Nucleases by attacking nucleic acid supply the precussor for cytokinin synthesis by liberating purine nucleotides. Proteases attack proteins, setting free tryptophan, the precursor for IAA. Cytokinin and IAA from the endosperm stimulate the embryo to cell division and cell elongation. The growing embryo breaks through the seed coat as the radicle while the coleoptile and grows upwards to form the shoot.

Studies on the effect of exogenons growth regulators in germination of light requiring seeds have shown the simultaneous involvement of different regulators. GA_3 and particularly GA_4 and GA_7 induce dark germination in most seeds. ABA inhibits promotion of germination by red light and GA_3 in light requiring seeds. Karseen (1976) distinguished two sites of hormoral action during germination of Chenopodium album seeds. He has it that visible growth is induced in darkness by (GA_4 + 7) or by ethylene. And that added cytokinins are inactive although 8-C^{14}-kinetin shows rapid penetration into the seed and rapid turn-over. A second site of hormonal action is located during the progress of growth inside the covering structures. ABA inhibits radicle growth, while GA_{4+7}, GA_3, kinetin, Zeatin and ethylene reduce the inhibition (see fig)

Schematic representation of the sites of hormonal action during germination Karssen (1976).



The active form of phytochrome (Pfr) has in seeds also an effect during both phases. The induction requires high level of Pfr whereas the growth of radicle has a continued but low Pfr requirement.

Flowering: Flowering involves the trans formation of some parts of the shoot from the vegetative to the reproductive stages of development. Almost all angiosperms flower sometime in their life cycle. In the tropics, for instance, majority of the angiosperms start flowering with the on set of rainy season. In the temperate regions, after the cold winters, flowers appear in springs. This never failing rhythm of flower/seed production is easily observed. It has become clear that environmental variables like temperature, light and photoperiods which stimulate the production of some phytohormones trigger off this flowering phenomena.

It has been established that the photoperiodic reaction of flowering proceeds in two phases, the leaf phase which is specific for photoperiodism and completely depends on daylength and the stem phase which is not specific for photoperiodism and does not depend on day length (Chailakyan, 1956a, Salisbury and Bonner, 1956, Lamg, 1956). Investigation of the hormonal nature of plant flowering in connection with their photoperiodic reactions has shown that flowering depends on a bicompenental system of hormones where GA regulates stem formation and growth substances of anthesin type regulate flower formation. Studies on floral initiation reveal that flowering depends on the hormones of flowering in the leaves. The complex of these active substance have been named "florigin". Later it was suggested that the florigin complex is made up of anthesins and gibberellins. On light quality during photo-inductive cycles, visible light of certain wave length has to be absorbed. Hence phytochrome mechanism essentially plays an active role in photoperiodism that leads to flowering. Flowering is however, prevented in xanthium by a brief flash of light (light break) of wavelength 620-660nm given during dark period of photoinductive cycle. Far-red radiation when used alone has no effect as a light break factor (Borthwick et al 1952).

Vernalization is a cold treatment of 5 to 10°C given to seedlings or buds so that they acquire the ability to flower in relatively shorter time. Hyoscyamus niger (henbane), a biennial plant can flower in one year if given a cold treatment than its normal two years period. Also venalized leaf of henbane, grafted to unvernalized henbane plant cause the latter to flower in time. The substance produced by vernalization is called "vermalin". GA is regarded as a substitute for vernalization. Therefore plants treated with GA, without being vernalized flower in time just as the vernalized plants. Lang (1957) demonstrated this by treating seeds with GA. Some workers believe in hormone theory of vernalization where flowering hormones are produced during vernalization. Others believe that vernalization helps in the increased production of AA and mobilization of carbohydrate plus high enzyme activity, ultimately lead to high metabolic index, thus ensuring quicker rate of flowering. AA is known as a good electron donnor. Rates of metabolism in plants affect flowering. Jacobson and Varner (1967) have shown that GA may affect metabolic changes through inducing synthesis or through activating several hydrolytic enzymes. Much evidence show the increase of AA towards the onset of flowering (Chinoy et al 1969, Abraham 1970). Vernalization and photoperiodic treatment help in raising the level of AA earlier than in the untreated plants in the shoot apex. The free radical of AA increases the energy pool. DNA complexes and AA exchange orbitals by their mobile electrons. This activates DNA followed by RNA synthesis. Production of structural proteins and enzyme protein is accelerated during the period of reproductive differentiation. Rate of cell division increases and high metabolic index thus achieved, ensures a change in nuclear constitution and there is emergence of flower instead of leaves.

Discussion and Conclusion:

Almost every dynamic part of plant growth and development seems to be affected by auxin. Auxin (IAA) appear to be a master phytohormone exercising regulatory action over many of the other plant hormones, In recent years the technique of growing excised plant tissues on defined media has provided a promising tool for investigating the problem of growth.

Avalanche of works by emminent workers show that hormone interaction is the key basis for the success of hormone controlled physiological processes.

It is very probable that no specific physiological process under hormonal control can be ascribed to the influence of only one hormone. Such interactions may be synergistic, in which one hormone reinforces the effect of another or antagonistic, in which one hormone offsets the effect the other. Also the ratio of the concentrations of the interacting hormones is important for some desired results.

It is very heartening to say that the knowledge gained from the unstanding of the roles played by various growth substances is rapidly being utilized in the present-day agricultural, silvicultural and horticultural practices. With the explanation of some other unclear physiological processes controlled by phytohormones and very wide application of crop production aids and other plant breeding techniques, Green Revolution, the current nation-wide campaigne for increased crop production will be a huge success.

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THE ROLE OF THE PLANT BREEDER IN THE SUCCESSFUL IMPLEMENTATION OF THE GREEN REVOLUTION PROGRAMME

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Who is the plant breeder? He is the artist or scientist who had benefit of training in the the fields of,

(a) Botany: In order to understand the taxonomy, morphology and repreduction of the plants with which he works;

(b) Genetics and cytogenetics: In order to understand the mechanism of heredity in plants since modern plant breeding methods are based on a knowledge of genetic principles and chromosome behaviour.

(c) Plant physiology: In order to be able to determine the response of plants to their environment - which includes heat, cold, drougth and soil nutrient response.

(d) Plant pathology: In order to understand varietal resistance which is an important means of combating many plant diseases.

(e) Entomology: In order to be able to breed for insect resistant varieties

(f) Plant biochemistry: In order that he might determine correctly, the industrial suitability, and consequently, the market demand of his new varieties of crops, e.g. the milling and baking qualities of a barley variety, or the fiber qualities of a cotton variety. Many chemical and physical experiments are required to test for these qualities.

(g) Statistics: The plant breeder measures the comparative performance of many strains. Hence, sound field plot techniques and methods for statistical analyses of data are necessary to obtain reliable results and to interpret the results correctly, Last, but not the least,

(h) Agronomy: In order to know the crops and their production. He should understand what the former <u>wants</u> and <u>needs</u> in the way of new varieties, so that he may be able to evaluate the breeding programme in the light of these needs.

Having seen the requirements of a plant breeder, it would appear that his role is so complex that his art may defy easy definition actually, this is not the case, as seen from the following:

The Oxford Advanced Learner's dictionary of current english defines breeding as an art of breeding animals, etc for the purpose of producing young ones, especially be selection of parents. It also went on to add that what's bred in the bone will come out in the flesh" - hence stressing the most fundamental aspect of breeding, that is hereditary characteristics always show themselves.

Although, the above definition is good enough for the layman, Poehlman, (1959) went a bit further with his definition that "plant breeding is the art and science of changing and imploring the heredity of plants" However, with Smith's (1966) definition, the relevance of this noble field to the Green Revolution is laid bare. He wrote and I quote, "plant breeding, broadly defined, is the art and science of improving the genetic pattern of plants in relation to their economic use" ..... unquote. Hence, the genetic remodelling of plants with an economic end in view, is the whole purpose of the art. Hence, it is a means to the achievement of President Shagari's (1980) prophecy, and I quote, "with the victory in Zimbabwe and impending liberation of Namibia and Azania in the very near future, the end of the struggle for political liberation in Africa is in sight" unquote, and the second phase of the struggle for independence - economic independence - must now begin. Agriculture is the linchpin of economic development and all that man eats, virtually without exception, are either plant materials or derived rather directly from plants as are meat, eggs and diary products, Plants are also the major source, directly or indirectly, of most clothing, fuel, drugs, and contruction materials. Moreover, as ornamentals, plants are both useful and aesthoetically pleasing considering the prime importance of plants, it is not surprising that men have long been concerned with developing types better suited to satisfying their needs - which incidentally is the kingpin of plant breeding. A cursory look at the development of the subject matter will give an insight into its role in the current fight to feed the teeming population of this country.

I will not attempt a detailed outlay because many years ago, according to legend, aruler of a sizeable kingdom became interested in the history of mankind. Exercising his kingly authority, he commanded his scholars to develop for him a "Complete History of Mankind". Ten years of research produced ten volumes - but the king asked that these be reduced to one volume. This was done to three sentences - "They were born. They suffered. They died".

Plant breeders have made a most significant contribution to the level of living of the people of Nigeria that permits consumers to worry about abundance rather than starvation. This fact was achieved from the modest trends which started about 2000 years ago when man's first attempt started in mesopotania. Records have it that the begining of deliberate plant breeding started with attempts to improve rice in China. It is understood that the first planned effort to create new plants may have been the breeding of new varieties of hyacinths and Tulips in the Netherlands.

Millington IN +(76, noted that anthers function as male organs, while Grew suggested the functions of ovules and pollens. Mather, in 1716 observed the effect of cross-pollination in corn while Fairchild, in 1719, is credited with making the first artificial plant hybrid - a result of the reconstruction of the plant's genotype. In 187̄5 Stransburger produced the first adquate description of chromosomes while further work by strasburger, Flemming and Boveri established the constancy of chromosome number in plant types. Crosses of Triticum sativum XT. turgidum T. durum and T. Polonicum.

where described by Henry de Vilmorin in 1878 while Beal. between 1878 and 1881 observed increased uields from hybrids between corn verieties and suggested the use of varietal crosses in corn production. The list of contributors to the development of the subject matter is impressive. Consequently, it has became advanced and more precise and beneficial endeavour. But what role can the Plant breeder play in the present exercise of Green Revolution?

As Burton (1960) puts it,"Economy conscious urban legislators oblivious of population explosion and thinking only of momentary food surpluses may soon realise that pangs of hunger, real or imaginary can only be sated through the use of the energy which comes to man from the sun by way of the green plant!! Consequently, there is a crucial role for the plant breeder, who knows how to improve the plant, and by so doing alleviate human suffering. The role of the plant breeder in the future can be seen from what role he has played in the past, His ultimate goal is increasing agricultural productivety. This can be accomplished by providing varieties basically more productive, not because of specific improvements such as disease resistance but as a result of generally greater physiological effeciency.

Better plant varieties can also be developed for new agricultural areas. The production of "irish" potato, Salanum tuberosum will be a welcome event in lowland and high humidity areas of Nigeria. It is hoped that the Andegina group will provide the gene combination necessary for the tuberization process to occur under the high temperatues which occur in the southern parts of Nigeria. A proven case of such an experiment is seen in the successful introduction of the grain sorghum into the more temperate climatic conditions of the American continent.

Mechanization of farm pratices has been recognised as crucial to the successful implementation of the Green Revolution - and so it is. However, most of our current farm crops have hardly been modified to suit the presently available mechanisation aids. Consequently, the burden falls on the Plant Breeder to improve on the agronomic and horticultural characteristics of these plants.

This is not an impossible task if the Plant Breeder is encouraged since - and once again, the case of the grain sorghum provides with ready example - the original variety of this crop was tall growing but breeding exercise has helped to produce dwarf varieties which has now made combine harvesting a practical undertaking.

Recent reports from Borno State have concentrated people's fears of impending famine as a result of expected ravages of farmlands by locusts. Not only that, in parts of Benue State, armyworms (Spodopthera armygera)had ravaged farmlands over the past few years. Hence, the prospect of the Green Revolution will NOT be attractive if all one gets at the end of a growing season is provide food for the wide range of agricultural pests and diseases. The Plant Breeder has the role of developing plant varieties which are tolerant or resistant to the ravages of these diseases and pests. An added advantage of resistant varieties is the stabilizing effect they have on production%. This is important not only to the farmer but to his nation as well. Reasonable harvests every year are preferred to the economic hardships associated with extreme fluctuations in yield.

Although, the main clause in the Green Revolution is increased productivity, the quality of the food or materials produced should not be overlooked. The Plant Breeder with his ever - present concern for human well-being, is also interested in those advances leading to improved quality of agricultural products. Examples abound in our midst. People have made allegations that our textile industries produce poor quality clothing materials. Most probably, longer and stranger staple cotton will remedy the situation. The quality of Allen 26 variety may not meet with the fine taste most recently cultivated by Nigerians as demonstrated by the "imported goods" craze.

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MACRO- AND MICRO-ELEMENTS AND THEIR ROLES AS WELL AS DEFICIENCY SYMPTOMS IN PLANTS:

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INTRODUCTION:

Life of all organisms depend on plants and plant materials for their growth and other metabolic activities. Green plants (autotrophs) can synthesize their own food using the radient energy of the sun. For maintenance of this and other important physiological processes in plants, adequate mineral nutrients must be present in their growth media.

CLASSIFICATION OF PLANT MINERAL NUTRIENTS:

Elliot et al. 1974; classified the various elements, required by plants into two main forms:-

(a) Macronutrient Elements:

These are elements which are required in higher amounts and they include C, H, O, N, P, S, Ca and Mg.

(b) Trace or Micronutrient Elements:

Which are elements required in trace or small amounts (i.e. Fe, B, Zn, Mn, Cu, Mo and Cl). still needed by some higher plants species and micro-organisms but not by others; and this made their sharp classification into Macro-or Micro-nutrients difficult. Cobalt (Co) for instance is required by some micro-organisms and symbionts (Evans and Kliewer, 1964); sodium (Na) is also needed by some blue green algae and halophytes (Brownell, 1965) etc.

Sachs (1860) and Knop (1865) were the earliest investigators to determine specifically (from their culture solutions) which elements are needed by green plants. The result of their experiments were later confirmed by many investigators including Hoagland-Snyder (1933) who were the first to include the element Molybdenum (Mo) before the essential nature of the element for higher plants was known; and it is today the widely used culture solution.

MINERAL UPTAKE BY PLANT ROOT:

Apart from C,H and O, the mineral nutrients required by plants are absorbed through the roots. These elements if in organic form must be converted into inorganic forms before they are absorbed, the process of which is MINERALIZATION. The opposite process is termed IMMOBILIZATION (Buckman and Brady, 1969). Various method of absorption include:

- Diffusion
- Passive uptake
- Active uptake and
- Massflow mechanism

Cell wall of plant roots contain negative charges which make uptake of cations by diffusion possible. The adsorption of these ions on cytoplasmic surface may not require metabolic energy and is termed PASSIVE UPTAKE. But if metabolic energy generated in respiration is needed, the process is termed ACTIVE UPTAKE (Mayer et al, 1973). Barber (1962); Drew et al, (1967) stated that ions can also move from the soil to root surface by massflow mechanism. The concept states that an increase in transpiration should also cause an increase in the absorption of ions.

ROLES/DEFICIENCY SYMPTOMS OF VARIOUS MINERAL ELEMENTS

MACRONUTRIENT ELEMENTS:-

(a) Phosphorous (P):-

Like nitrogen, it forms an important structural part of many compounds like nucleic acids, nucleotides and phytic acids (Nason and McElroy, 1963; William, 1969); phospholipids and ATP (Devlin, 1975); and indeed plays a key role in energy metabolism and transfer. Heavy concentration of phosphorous has been reported in the meristematic regions of actively growing plants, where it is involved in synthesis of nucleo-proteins, Phosphorous, a constituent of phospholipids; along with protein form an important constituent of cell membrane and thereby play an important role in ion transport across the cell membrane - Bennet Clark (1956).

DIFICIENCY SYMPTOMS:

Includes acute leaf angle (necrosis) lack of tillering as in flax (Linum usitatissinum), premature leaf fall and purple or red anthocyanin pigmentation (wallace, 1961).

Prolonged dormancy of lateral bud; decreased in size and number of flower primodia; suppression or delaying of flowering and few but small friuts or seeds are evidences of phosphorous difficiency. Total plant biomass could be reduced - Troughton (1976).

(b) Nitrogen (N)

Perhaps, most important role is its part in structure of protein molecules. Nitrogen also form an important constituent of nucleotides (purine and pyrimidine bases), porphyrines, aminoacids, amides and co-enzymes. Puriner and pyrimides are found in the nucleic acids, RNA and DNA which are essential for protein synthesis. Porphyrine structure is found in such metabolically essential compounds like chlorophylls and cytochrome enzymes needed in photosynthesis and respiration.

DEFICIENCY SYMPTOMS:

Characteristic Symptoms are reduction in growth rate and development of chlorotic conditions. In most cereals, grasses, potatoe (Solanum tuberosum),tomatoe (Lycopersicon esculentum) etc, leaves become more erect than normal. In addition to yellowing of leaf following loss of chlorophyll, purple colouring of leaf, petioles and veins, caused by anthocyanin may be observed - Devlin, 1975.

Lateral buds often remain dormant and may result to absence of tillers in cereals, and many other plants like tomatoe, clover (Trifolium Sp) developes thin or spindly habit due to reduced growth of lateral buds.

(c) Potassium (K)

Specific role of the element is still uncertain, but it's highest concentration is found in meristematic regions of plants especially the buds, young leaves and root tips where it is supposed to perform metabolic functions (Nason and McElroy, 1963).

Potassium appears to serve a number of catalytic roles since many enzymes resposible in protein synthesis do not act efficiently in absence of the element, but the exact nature of much of the potassium requirement is uncertain (Bidwell, 1979).

Penny et al, 1975 reported increased dryweights in plants supplied with potassium.

DEFFICIENCY SYMPTOMS:

Usually begins with a characteristic mottled chlorosis of older leaves, followed by younger ones (Bidmell, 1979). Chlorosis may be followed by necrosis at the tip and margin of the leaf (Devlin, 1975). In many cases as in tomatoe (L esculentum), the leaf tip curve downwards, (Hewitt, 1963). Shortening of the internodes occur in many plants including broad bean (Vicia faba), Mustard (Sinapsis alba)etc.

(d) Sulphur (S)

It's obvious function is participation in protein structure (e.g. Sulphur bearing amino acids) Cystine, methionine (Bidwell, 1979); and some biologically active compounds like glutathione, biotin and thiamine (Devlin, 1975).

Sulphur is also required as a co-factor by some enzymes involved in hydrolysis of ATP and phospholipids; and form an essential component of amlylases in certain bacteria and fungi.

DEFICIENCY SYMPTOMS:

Resemoles that of nitrogen deficiency which is characterized by general chlorosis, followed by production of anthocyanin pigments in leaves. But unlike nitrogen deficient plants, chlorosis is first noticed in younger leaves.

Hall et al (1972) reported a marked decrease of stroma lamellae with increase in grana stacking of mesophyll chloroplasts in corn plant (Zea mays) deficient in sulphur. Metabolic distrubances following sulphur-deficiency may be profound, largely because the plant is unable to make proteins due to shortage of sulphur -containing amino acids; thus soluble nitrogen as well as rich amino acids (Glutamine and Arginine) tend to accumulate.

(e) Calcium (Ca):

The most important role is its part in cell wall formation in form of calcium-pectate, Devlin, 1979. Calcium has been reported or noticed to play a role in the continued growth of apical meristems; in the absence of which mitotic division become aberrant or suppressed (Mayer et al; 1973). In respect of this, Hewitt, 1963 suggested that calcium may be involved in chromatin or mitotic spindle organisation.

Costes et al (1975) indicated that supply of calcium increased number of flower and capsule as noticed in *Papaver somniferum L.*

DEFICIENCY SYMPTOMS:

Meristematic regions at root tips, stems and leaves are generally or greatly affected and eventually die, thus terminating growth in these regions. Roots may become stunted and discoloured (or brown as in tomatoe) (*Lycopersicon esculentum*). Chlorosis of margin of younger leaves, "hooking" of leaf tips may occur.

Calcium deficiency may reduce or limit seed production even when the flower formation is otherwise normal as in *Vicia faba*, (Hewitt, 1963). Complete absence of calcium appeared to result in profound changes in cell behaviour (Sorokin and Sommer, 1929; 1940). Normal mitosis have been reported absent in peas (*Pisum sativum*); which led to incomplete separation of chromosomes and aggregation of chromatin into granules or lumps. Some cells fail to produce new cells walls after division, and binucleate cells observed especially when cells appear to have lost most of their cytoplasmic contents; a polyploidy situation may possibly result.

(f) Magnesium (Mg)

Is a mineral constituent of chlorophyll molecules in chlorophyll bearing organs (Mayer et al, 1973). Magnesium plays a role as an activator for a number of enzymes involved in synthesis of nucleic acids, DNA, RNA as well as enzymes required in cabohydrate metabolism (Devlin, 1975).

DEFICIENCY SYMPTOMS:

Chlorosis, which may later be followed by anthocyanin pigments would be noticed on the leaves (Devlin, 1975). In severe cases, necrotic spottings may appear as in potatoe (solanum tuberosum).

MICRONUTRIENTS ELEMENTS:

(a) Iron (Fe): Iron is indispensable in synthesis of chlorophyll in green plants, but its chemical role in such chlorophyll synthesis is uncertain (Nason and McElroy, 1963).

Some of the enzymes and carriers which operate in the respiratory mechanism of living cells are iron compounds (e.gs Catalase, per-oxidase, Ferredoxin and Cytochromes); thus performing important roles in cellular metabolism (Mayer et al, 1973).

DEFICIENCY SYMPTOMS:

Most characteristic is failure to produce chlorophyll in young leaves. In several, total bleaching and colapse of whole leaf may follow in severe condition (Heiwitt, 1963).

Fruits of tomatoe (L esculentum)become silvery green and are orange rather than red ripe (Hewitt, 1944).

The protein nitrogen content of plant is lowered in iron-deficient plant. Restoration of iron supply increased protein synthesis (Devlin, 1975).

(b) Manganese (Mn)

Is found in physiologically active parts especially factor in oxidation-reduction process, especially in relation to iron compounds (Mayer et al 1973).

Manganese play a direct role in photosynthesis as observed from decrease in rate of photosynthesis in algae at an early state of manganese deficiency.

DEFICIENCY SYMPTOMS:

Characteristic chlorotic and necrotic spots in the interveinal areas of leaf may be observed which first appeared on young leaves of some species (e.g. tomatoes - L esculeutum). In other species (e.g. Phaseolus vulgaris) the symptoms may appear first on older leaves.

Manganese deficiency appears to have marked effect on chloroplasts, Eltinge (1941), stated that the ehloroplasts lose chlorophyll and starch grains turning yellow, become vacuolated and granular; and finally disintegrates when Manganese is in deficient supply.

(c) Boron (B)

Its role in plant metabolism is not clearly known as yet (Bidwell, 1979), but Gauch and Dugger, 1953; 1954; proposed that borate ion may be associated with cell membrane where it could complex with sugar molecule and fasilitate its passage across the membrane.

Boron has recently been demonstrated capable of breaking seed or caryopsis dormancy (e.g Themeda triandra (Cresswell and Nelson, 1972) a process capable of doing by an important plant hormone -Gibberelic acid (GA).

Cresswell and Nelson, 1973 also indicated that boron play a role in the RNA metabolism in plants (e.g Themeda triandra (Forskseed), another process which GA_3 can also perform.

DEFICIENCY SYMPTOMS:

Leaves tends to thicken and darken, and meristems of shoots, and roots die, giving the plant a stunted and bushy appearance as in "top sickness" of tobacco (Nicotiana tabaccum)- Bidwell, 1979. Interveinal tissues and minot veins may be crinkled. Basal regions or margins of young leaves often become chlorotic and then necrotic as in tobacco.

Flowering is often totally suppressed but if developed may fall without producing seeds, probably due to effect of boron deficiency on pollen tube growth. Fruit when formed is often obnormal in a severe condition.

(d) Zince (Zn)

Zinc is directly involved in synthesis of indole-3-acetic acid (IAA); a plantauxin or hormone. Thus, its deficiency may cause substantial changes in form and growth habit of some species (Tomatoe - L esculentum), producing shortened, stunted plants with poorly developed apical dorminance (Skoog, 1940).

An accumulation of inorganic phosphorous in Zn-deficient tomatoe plant suggest that Zinc may act as an activator for some phosphate transfering enzyme like hexose Kinase or triosephosphate dehydrogenase.

Zinc also play an important role in protein synthesis since it's deficiency may result in a substantial increase in soluble nitrogen compounds, such as amino acids and amides (Possingham, 1956).

DEFICIENCY SYMPTOMS:

Generally, first symptom is an interveinal chlorosis of older leaves, starting at the tips and margins. Seed production is adversely affected or depressed by lack of Zinc in beans (Phaseolus vulgaris), pea (Pisum sativum) and other plants Reed, 1942.

Fruit size is generally reduced in citrus (Citrus sp). Inflorescene development is badly affected (Riceman and Jones, 1958).

Copper (Cu)

Copper plays exclusive catalytic role in plants being a component part of number of important enzymes such as polyphenol oxidase and Ascobic acid oxidase (Nason and McElroy, 1963).

Copper may function in photosynthesis by being present in chloroplast in copper-containing protein (Plastocyanin); an important member of the photosynthetic electron transport system. Copper supply has been found to increase fresh weight of wheat (Triticum alstivum L) - Hill et al, 1978.

DEFICIENCY SYMPTOMS:

Most easily recorgnised ~~are~~ is disease of fruit trees called "exanthema" or "Summer die back". Leaves are often initiallly darkgreen, though atimes twisted and may be borne on abnormally vigorous "water shoots" which is citrus (Citrus Spp) become curved or S-shaped. Terminal leaves may show interveinal chlorotic mottling. Leaves become necrotic, sometimes begining with death of the leaf tip in cocoa (Theobroma Cacao) - Maskell et al 1953.

Flowers of broadbean (Vicia faba) lose their dark purple or brown pigmentation on the keel which become pale brown when copper is deficient.

MOLYBDENUM (Mn)

It plays important part in enzyme system which catalyzes reduction of nitrates to ammonium ions, or nitrate reduction and nitroges fixation. Thus its deficiency especially in plants having symbiotic nitrogen fixation (e.g Legumunoseas), results in a reduced nitrogen content - Bidwell, 1979.

Molybderum helps to restore normal levels of ascobic acid (AA) in plants. Asobic acid is an important phytohormone which is involved in growth and development in plants (Chinoy, 1964; Abraham, 1970).

DEFICIENCY SYMPTOMS:

This may begin with chlorotic interveinal mottling of lower leaves followed by marginal necrosis and infolding of leaves. In some plants, young leaves are greatly distorted; having a long midrib and narrow, poorly developed, often ragged blade (i.e "Whiptail disease") as in Cauliflower (Brassica Oleraceae Var Botrytis) Devlin, 1975.

Chlorine (Cl)

According to Mayer et al (1973), it acts as an enzyme activator in the water splitting reactions of photosynthesis. But the role of chlorine in this respect is still obscured.

Warburg and Luttgens (1946) stated that Chloride ions were essential for the production of oxygen by isolated chloroplasts from Spinach (Spinacia oleracea).

DEFICIENCY SYMPTOMS:

There is first a pronounced development of wilt in the apical leaflets of the lower leaves. This has been also associated with restricted growth of the tissue and leaflets show marked reduction in width of apex or become necrotic.

Multiple branching of lateral roots, with clubbed tips is a characteristic effect of chlorine deficiency in Tomatoe (Lycopersicon esculentum).

CONCLUSION:

Plants require most growth and metabolic mineral nutrients in ionic forms. These minerals nutrients (except C,H and O) are absorbed from the soil through the roots which have special absorption properties.

The various absorbed nutrients particcipates or have special roles that are involved in protein synthesis, enzyme activation, chlorophyll formation and other growth and metabolic activities going on in plants.

Deficiency of any of the mineral nutrients in plants may lead to both internal and external changes like stunted growth, poor root and flower or friut formation, chlorosis etc; all of which affect total veild.

Unfortunately, the detailed effects or roles of most essential nutrients are still uncovered. This indeed posed great challenge to plant physiologists or plant biologists since organisms (including man) depend for their living directly or indirectly on plants and plant materials. Finding solutions to these problems will ultimately lead to increase yield and productivity especially in this time of our green revolution.

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THE QUESTION THAT MUST BE ASKED

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Imagination, creativity, faith and madness seem to blend together to form a scientific okro cum vegetable soup from which the most "absurd" observations become reality. "How ridiculous it might have seemed in 1902 when Gottliab Habarlandt conjectured that one might be able to create an entire plant from a single cell - the smallest living unit of any plant".

Unmitigated idiocy absolute madness but plants, like animals, usually grow from an egg penetrated by sperm. How could anybody create a plant from a single cell?

That was a question that other 'mad' scientists were asking themselves in the 1930s as they conducted studies on the life processes of potatoes. They observed that when potato slices were exposed to moisture and air, some of the cells began to act very strangely, developing in ways similar to fertilized egg cells. It must be noted that after world war II, scientists again noticed a similar bizarre behaviour of individual carrot cells immersed for experimental reasons in a mixture of coconut milk and salt solution. The milk acted like a nutrient for the carrot cells with which the scientists were working.

The arrot cells were dividing mexplicable as if they were trying to form a whole plant. Do I say they were mimicking the process which normally could only begin with a combination of plant sex cells? This behaviour of carrot cells in a mixture of coconut milk and salt solution negate the laws of nature, what I would want to term Botany 000001 (common sense).

Mature plant cells were not supposed to behave in this odd way, but they did, and that was what mattared.

In continuing work with carrot cells the scientists observed that milk seemed to provide not only nutrients for the cells but a special and mysterious stimulus to cell division. In other experiments the scientists found that potate cells acted differently from carrot cells. To me this suggests that plants are not dogmatic and therefore each plant needs a unique medium in which to act in the bizarre way that the carrot cells acted.

One important thing emerged from the above discovery and that is that one does not need sex cells to form individual plants, that is to say that one can make a new plant from cells taken from - mature plants. And since each plant contains millions of cells you would say, that it is possible to create any number of new and identical plants from a parent plant. This could have been possible but for our hostile attitudes towards plants.

If a plant could be formed from a single cell, would man be able to do this with higher animals and particularly himself? Now that work on the eggs of frogs have shown that the ganetic material transferred into a single cell could lead to the development of an adult frog. Is this same work not extenable to man's reproductive processes?

This may make me appear like a fool puting forward the above question. But a little look at the not distant past may make me appear less foolish. Because when one considers that issue of the successful delivery of a test-tube baby in the year 1978, than it is possible to set on such a time consuming exparimont suggested above.

This leads me to the question that now demands an answer; "Shall we one day wake up to hear of <u>A-SEXUAL REPRODUCTION IN MAN</u>? Or would man be able to reproduce <u>HIMSELF</u> from a single <u>CELL</u>?

This is how I think we can go about answering the above question. Just like the case of a test-tube baby, the other ganetic materials an egg requires from a sperm can be developed artifically, thus making a woman independent of a man in a child formation. After all, Jesus was an example of asexual Reproduction. And if the bible says and I quote "As it was in the beginning so shall it be now and for ever more". Although I am a Godian, but a sience student, I think it would be interesting if we have parthenogenetic Homosapians.

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