LADOKE AKINTOLA UNIVERSITY OF TECHNOLOGY OGBOMOSO

INAUGURAL LECTURE
SERIES 1

TITLE

KEEPING PESTS OUT OF THE GARDEN

DELIVERED BY

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ON THURSDAY 27TH JANUARY 1997
IN THE M.K.O. ABIOLA LECTURE THEATRE AT 2:00PM.

Kabiyesi, Soun of Ogbomosoland, Oba Jimoh Oyewumi Ajagungbade III,

Chancellor, Basorun M.K.O. Abiola,

Pro-Chancellor and Chairman of Council

Vice Chancellor, Professor O.L. Oke who has the honour to chair the first inaugural lecture in this great citadel of learning.

Principal Officers

Deans,

Heads of Departments and other Professors,

Fellow Lecturers,

Professors and Colleagues from other universities, Polytechnics and Colleges of Education,

Students of LAUTECH,

Distinguish guests,

Ladies and Gentlemen.

KEEPING PESTS OUT OF THE GARDEN

For the next 60 minutes I will be taking you round the world in a jet built by Cydia ptychora (Meyrick), powered by Neodiprion pratti banksiana Rohwer, air-conditioned by Zonocerus variegatus L. and piloted by Julius Ipadeola Olaifa (Captain) with Professor A.E. Akingbohungbe, Professor Fumio Matsumura and Professor A.O. Adenuga of blessed memory as copilots assisting the Captain. Please observe with me one-minute silence in memory of an astute administrator, excellent scientist and a man with a good deal of human nature in person of Professor Atanda Okunola Adenuga who died on May 27, 1993. May his soul rest in perfect peace.

Our journey started at Ile-Ife after a one-year sojourn at Ibaa near Port Harcourt where I first had a taste of fish pepper soup at Okrika Archipelago Hotel. The year was 1976 when as a graduate student in Plant Science at the Obafemi Awolowo University, Professor A.E. Akingbohungbe introduced me to the cowpea pod borer Cydia (Laspeyresia) ptychora. Within the period of 1960 and 1970's C. ptychora which alone accounted for more than one-quarter loss of the total annual cowpea production in Southern Nigeria (Taylor 1965) had distinguished itself as a major pest of the flowering and podding phase of cowpea. This pest defied chemical control (Ayoade 1975, Dina 1977) as there were many gaps in the knowledge of its biology. Our intervention (Akingbohungbe, et al 1980; Olaifa and Akingbohungbe, 1980, 1981, 1982 a,b) provided these biologic information:

a. life history and life stages of C. ptychora unknown before then were described.
b. complex reproductive strategy such as accurate assessment of available food by the female before eggs are laid on sepals; only the first instar larva that is usually too small to be recognised by humans and predators is found on the pod and larval development occurring in the leaf buds and inside flowers when pods are limiting, were elucidated.
c. seasonal population fluctuations in C. ptychora showed more females were produced when food was abundant and environmental conditions optimal.
d. fourteen native parasites and predators were found to be regulating the population of C. ptychora., Of these, Bracon hancocki (Wilkinson) was major and its potential for biological control was elucidated and recommended.

It is gladdening that with these information, control strategy was recommended which enhanced performance of natural parasites and predators and made chemical control more effective. Thus C ptychora which used to be responsible for more than 50 percent of crop loss in cowpea had been reduced to a non-pest status since a decade

and half ago. We thus have succeeded to keep the C. ptychora pest out of the cowpea garden through sound biological investigations.

Our plane took off from Lagos on September 27, 1980 and arrived at the J.F. Kennedy Airport New York City, USA 5 a.m. of the second day. In America we were determined to keep the pests out of the forest gardens in the temperate world. Plagued by similar coniferous forest the chief of which is the pine tree in the Mid-west USA it is possible to travel long distance in the rural area without encountering more than one species of these evergreen pine trees. It is the tree for wood, furniture, construction, religion and the industry in Michigan. As important as pine tree is to the economy of USA and other temperate world, it is being defoliated extensively by pine sawflies. They are called sawflies because with the aid of their egg laying structure they often cut the pine needle in a characteristic manner to place their eggs inside the needle where they develop to the first instar larval stage. These defoliators are pine tree specific as shown in Table 1.

Table 1. Defoliators of pine trees in Michigan USA

Defoliators	Pine Species
Neodiprion nanulus nanulus Schedl	Jack pine Pinus banksiana L.
Neodiprion pratti banksianae Rohwer	Jack pine Pinus banksiana L.
Neodiprion pineturm (Norton)	White pine Pinus strobes L.
Diprion similis (Hartig)	White pine Pinus strobes L.
Neodiprion sertifer (Geoffroy)	Scotch pine Pinus sylvestris L.

You will appreciate the fact that controlling forest insect pests can be a difficult and expensive task. Any spray must be applied from the air and aerial spraying is always

associated with drift. Our approach to keep the sawflies out of the forest was to utilise a semiochemical referred to as sex attractant or sex pheromone which is produced by female sawfly to invite male sawfly for sex.

Using sophisticated methodology, the sex attractant of the pine sawflies was identified as either acetate or propionate esters of 3, 7 – dimethylpentadecan – 2 -01 (diprionol) (Jewelt, et al. 1976). With three asymmetric carbon centers in the structure of diprionol, eight optical isomers are possible. The eight optical isomers and racemic diprionol were field - tested, thus we recognized that:

1. All pine sawfly species utilise one pheromone - the acetate or proprionate ester of diprionol (Kikukawa et al. 1983).
2. all the fall-flying Neodiprion species respond mainly to the acetate of diprionol while the summer flying species respond to either acetate or propionate diprionol (Olaifa et. al. 1984).
3. the nature of chirality of the natural pheromone was 2S, 3S, 7S for Neodiprion species but 2S, 3R, 7R for Diiprion and Gilpina species (Olaifa et. al. 1984).
4. synergistic interaction was found among the optical isomers with erythro 2S, 3S, 7S (SSS) isomer being the major and threo 2S, 3R, 7R(SRR) or 2S, 3R, 7S(SRS) the minor isomer (Olaifa et. al. 1987 b & c).
5. most of the Neodiprion species are sympatric species(i.e half brothers) that are using that critical species specific blend optical isomers as the major mechanism for reproductive isolation.
6. in the sawflies, the females play the key role of selecting the host plant and the oviposition site; males on the other hand are able to fly long distances. The females release the pheromone from the abdominal glands and fan the wings to drive the pheromone into the winds. The erythro isomer (SSS) is used as

long distance sex attractant to draw males close to the vicinity of the female sawfly. The second isomer SRR or SRS serve as a chemical discriminator which selectively inhibit the approach of alien species (Olaifa 1984).

7. having obtained this powerful pheromone with the right chiral configuration, and having studied the behavioral response of the sawfly to the pheromone, we discovered that the pheromone elicited the following unusual behavior in the males. Appetitive flight towards the silhouette on which the female insect is begins immediately the pheromone is perceived. This is followed by wing fanning after landing. Abdominal tip is raised, and reversing ambulation is followed by a short positive consummatory flight which is terminated on the virgin female. Copulatory activities involving stroking of wings and legs of the female, rear-to-rear positioning and dorsal or lateral abdominal mating for 10 minutes followed. After mating, the male always cleaned the legs, antennae and wings before it flew away rapidly. (Olaifa 1984).
8. while carrying out these studies in USA, we made a brief visit to Japan. During this brief stopover in Tokyo, we employed two chemistry wizards Professor Keinji Mori and Akira Tai to probe into the chemistry of the pheromone and produce for us large quantity of the synthetic pheromone. They successfully produced the pheromone with optical purity (Mori et. al. 1978; Tai etal 1978 Kikukawa et. al. 1982). When placed in the garden containing the host plant, the resident or invading male sawflies are attracted by the pheromone into sticky trap and killed. This technology has been adapted not only in USA but also in Europe to keep pine sawflies out of the pine coniferous forest of the temperate world. This product is awaiting a

parent in Nigeria especially now that pine trees are being cropped for afforestation programmes, such a parent could be one of you.

From
Form Nigeria to USA to Japan and Europe back to USA lasted four good years. Having made the impact(Olaifa 1984) and having been tired of MacDonald's Hamburger and fishing in Higgins Lake as well as scaring near miss gun shots in the woods of Kalkaska during the fall hunting season while I was busy chasing sawflies, we took a night flight out of the USA and arrived in Nigeria October 4, 1984 to a warm welcome by colleagues, friends and relatives. There is no place like home.

We arrived in Nigeria at a time when the grasshoppers Zonocerus variegatus L., Spathosternum pygmaeumo, Oxyla hyla, Cartantops melanostictus and Atractomorrpha aurivilii from the southern Nigeria and Oedaleus senegalensiis (Krauss), Kraussaria angulifera Krauss and Ornithacris turbida (Walk) from the guinea and sudan savannah zones of northern Nigeria were making serious impact on our crops. Zonocerus grasshopper had organized its race into an efficient agent of destruction that was capable of causing devastating defoliation of food crops especially cassava Manihot esculenta Crantz, the most important staple foods in southern Nigeria and many parts of Africa. In attacking any garden or farm, grasshoppers would organize into up to five formations of suicide squads. Should the first formation be wiped off with insecticides, the second formation would come in. By the time the third and fourth formations descend on the crop, total crop defoliation should have been achieved and the farmer should have lost both the crop and the insecticides. The potent insecticides (decamethrin, cypermethrin, lindane and dieldrin) for grasshoppers(Olaifa 1986) were also rendered inefficient because of this military mode of attack of these defoliators. It was therefore evident at this point that an insecticide which has only acute toxicity mode of action could not be the answer to grasshopper control.

There was also the growing realization in Nigeria of mammalian toxicity and environmental pollution caused by insecticides whose mode of action was acute toxicity.

We turned at this stage to the vast store of chemical substances in plants not only for grasshopper control but also for the control of pests on vegetables, cowpea, cattle and even humans. Having screened many ecologies and plant species for insecticidal activities we championed the cause of using phytochemicals for keeping pests out of the garden in Nigeria. We were encouraged in this pursuit by some world renown scientists like Professor Martin Jacobson of the U.S Department of Agriculture Beltsville, Maryland USA; Professor H. Schmutterer, Institut fur Phytopathologie and Angewandte Zoologie, Jutus-Liebigs Universitat, Giessen, Germany; Professor E.D Morgan, Departmnet of Chemistry, University of Keele. Stanffordshire United Kingdom and Professor (Dr) S.N.H Nagvi of the Department of Zoology, University of Karachi, Pakistan. The Third International Neem Coufersuce at Nairobi Kenya 1986 first brought me face to face with these scientists.

No plant can be better utilized for pest control than neem Azadirachta indica. A Juss(Yoruba/Hausa/Ibo: Dogonyaro) that was known to have originated from south-east Asia and introduced to Afica at the beginning of 20th century because of its rapid growth and drought resistance. In northern Nigeria neem is being used for shade and afforestation programmmes. In southern Nigeria, neem is also the choice tree for shade and hedges. Insecticide(mainly azadirachtin) exist in various parts of the tree but the seed is the richest source(Olaifa and Adenuga 1988a) followend by the leaves (Olaifa and Akingbohungbe 1987).

We extracted, purified and formulated neem seed into a potent antifeedant insecticide which made grasshopper, armyworm and stem borers to lose appetite for food and starve to death. The formulation christened LOCUST LOTION (Olaifa et. al. 1993) selectively

makes the natural enemies of these pests to become active therefore killing the grasshoppers, armyworm and stemborers that are sick at this time of high blood pressure(Olaifa et al 1991a). This single work represented a major success story. For example, titled "Extracts surpass synthetics for suppressing grasshoppers", the Rodale Institute Research Center, Philadelphia USA on their own re-published our work in the 1991 International AG.SIEVE editions of English and French languages(International AG SIEVE 1991). Also titled Neem Extracts Tested, the FARM Forestry News in 1992 also re-published our work for a wider audience(Farm Forest News 1992). At the home front the Federal Ministry of Agriculture and Natural Resources, Department of Livestock and Pest Control Services organized four National workshops at Ibadan, Ile-Ife, Bauchi and Kaduna in 1988 to train local farmers on the preparation and use of LOCUST LOTION. In the same year, the same Ministry published Farmers Advisory Bulletin titled "Protecting field crops with Locust Lotion – a natural locally sourced insecticide" in four languages English, Yoruba, Hausa and Ibo for distribution among Nigerian farmers (Olaifa and Adenuga 1987 Olaifa and Adenuga, 1988 b,c,d,e) It is gratifying that since the adoption of this technology by the farmers, damaging levels of Zonocerus grasshoppers, stemborers and armyworm have been kept out of the gardens in Nigeria.

In formulating the neem insecticide, we developed the emulsifier from the fruits of aridam Tetrapleura tetraptera L. (Orafidiya et al. 1994). The aqueous extract of T. tetraptera proved to be a better emulsifier than the commercial emulsifier quillaia tincture B.P. The importance of this approach in which the active ingredient (azadirachtin from neem) and the emulsifier (saponin from aridan) are locally sourced and formulated into a stable, yet effective insecticide without extensive chemical or solvent import cannot be overemphasized in developing countries where technology is inadequate and economy is not strong to support importations of organic chemicals.

For the grasshoppers we did not stop in our quest for its control with the production of LOCUST LOTION alone which is autifeedant, oviposition disruptant, photostable, non-phytotoxic, harmless to humans and non-target predators, compatible with symthetic pesticides, biodegradable, soil enriching and an effective mutative bioassay with enduring bioefficiency; we went two steps further. First, we isolated and identified estragole for the first time as the major component of the volatile oil of the leaves of Clausena anisata Hook (Rutaceae). This component was found to be acutely toxic to the variegated grasshopper Z. variegatus (Okunade and Olaifa 1987). Treated insects become restless tucking their heads ventrally and dying within 24hr.

No matter what kind of killing agent is applied, efficiency of any control is improved by a sound biologic information. In order to have a fore knowledge of the population of grasshoppers to be expected during the cropping season, we devised means of assessing the population of their eggs during the off season. This methodology known as Egg Pod survey Technique was developed by us in association with Dr. G.K.A. Buahin of the University of Maiduguri as well as Federal Department of Livestock and Pest Control Services. Abuja (Olaifa and Adenuga 1988).

Based upon these findings (Locust Lotion, estragole, egg pods survey technique) a comprehensive management system for grasshopper which is entirely biological, renewable and sustainable and to be known as Biotic Integrated Pest-Management System (BIPS) is hereby recommended for adoption in Nigeria. BIPS for grasshopper is to have these operational components.

i. Eggpod survey at the beginining of the reproductive diapause of the insect Grasshoppers overwinters in egg stage in Nigeria.

ii. Collection of adequate quantity of neem materials for extraction and formulation into botanical insecticides or purchase of adequate quantity of LOCUST LOTION towards the end of the reproductive diapause of the insect.

iii. Controlling with botanical insecticides such as pyrethrum or formulated estragole from Clausena anisata the 1st and 2nd nymphal instars of the grasshopper at 5 – 10m border – corridors of the farm.

iv. Applying LOCUST LOTION (home made or commercial) to the crop before the 3rd instars descend on the crop. The 3rd nymphal instar usually initiates attack on the crop.

There are other by-products from the neem fruits apart from the ingredients for the LOCUST LOTIONS e.g.

a. The neem oil from the seeds when applied in vagina is spermicidal. Pharmaceutical industry can therefore have an industry on the neem oil raw material to produce vaginal contraceptives (Sinha et al. 1984).

b. The pulp from ripe fuirts can be made into venigar and alcoholic beverages.

c. Water – washed neem cake is a protein rich cattle feed

d. Neem oil is also used for lighting and heating.

e. Neem leaves have high protein (15%) and low cellulose content and are good food for goats and sheep.

f. Neem leaves can also be used as a green manure and mulch to enrich soils.

g. Refined oil from neem can also be used in ointments, soap, tooth paste, cosmetics, denaturant and edible fats.

h. The complementary use of the neem cake with nitrogen fertilizer has been proved in view of the fact that neem cake reduces the growth of the nitrifying bacteria. This

reduces the breakdown of nitrogen from fertilizer and so optimizes the efficiency of fertilizer application.

We also utilized the essential oil of the black pepper Piper guineense Schum and Thonn (Yoruba: iyere) prepared as aerosol for the control of cowpea weevil Callosobruchus maculatus (F.). This volatile oil at 0.002 – 0.005% prevented the weevil from laying eggs on the cowpea and where the eggs had been laid, prevented the young (larva) from growing to adult (Olaifa and Erhun 1988). The same product was toxic to Acrae eponina Crammer on Corchorus olitorius L. (Yoruba: ewedu), cotton stainer Dysdercus superstitiosus F. on cotton, the cowpea flea beetle Oothcea mutabilis Sahlberg and the pod sucking bug Riptortus dentipes F. on cowpeas. The steam distillates of the leaves of Lippia adoensis Hoschst also shared similar toxicity as the Piper guineense to the above named insects (Olaifa and Erhun 1988).

The green peach aphid applied Myzus persicae (Sulzer) is a major pest on many important food crops. The aphid is highly polyphagous and can tolerate many plant allelochemicals. Being an efficient phloem feeder the plant nutrients are diverted resulting in a weakened or dead plant. The aphid also serves as a vector for plant mycoplasmas and viruses by introducing them into the translocating phloem. Because the host range of M. persicae extends to some cultivars of castor bean plant Ricinis communis L., many authors thought that allelochemicals were either xylem translocated (Guthrie et al. 1962) or restricted to specific storage tissue (Harbone and Mabry, 1975).

We developed an improved technique for ricinine analysis which clearly showed that green peach aphids fed on castor bean plant died as a result of ingestion of ricinine. We have thus established the idea that phloem - translocated alkaloids may serve as factors which enable plant to resist aphids and that the difference between a susceptible and

resistant plant for phloem feeders many therefore be due to the extent of xylem translocations relative to phloem transport (Olaifa etal. 1991).

Tick ectoparasitism on cattle is a major problem in Africa where they are responsible for transmitting quite a number of diseases. Ticks are known to develop resistance to many synthetic insecticides, therefore in order to safeguard successful tick management for the future, the development of novel active ingredients form local materials is inevitable. We exploited and prepared into effective acarcides for the control of ticks these six Nigerian plants: Hemizygia welwitschii, sweet orange Citrus sinensis, lemon Citrus Limon, Lippia adoensis, grape Citrus reticulata and Piper guineense. The volatile oil of these plants can be formulated into spray-on solution or as emulsifiable concentrates to be used in dip for tick control (Olaifa and Ayeni 1991).

Of the whole population of Africa, 80% i.e. 400 million people live in areas where little has been done to control malaria transmission and where the problem remains virtually unchanged or is worsening. In Nigeria and many countries of Africa, governments are so poor (or appear to be so) that they spend an overage of only US #4 per person per year on health care (TDR News 1990).

Preventive measures to control malaria vectors in Nigeria is virtually dead as the government can no longer avoid the cost of synthetic insecticides and the logistics of the control. Our contribution to mosquito control is two-fold.

i. We discovered the oviposition deterrent effect and larvicidal action of Petiveria alliacea (Yoruba: Tarzan Igbo) against Aedes aegypti (vector of yellow fever) and Culex pipens fatigans (vector of fiearíasis). The aqueous extracts of the roots of P. alliacea could be used in a neighbourhood mosquito control programme to protect potential breeding sites from egg-laying female mosquitoes thereby reducing the

menace associated with these ubiquitous pests (Adebayo and Olaifa 1994) (Adebayo and Gbolade (1996).

ii. We also find in the volatile oil of Hemizygia welwitschii repellent action against female Culex pipens fatigans (vector of filariasis) Anophees gambiae (vector of malaria fever) Aedes aegypti (vector of yellow fever (Olaifa 1991) and Culex albiventris a mosquito species which frequently attacks humans and with the capability of prolific breeding in clear ground pools around human habitation in west Africa (Olaifa and Jibodu 1990).

The volatile oil of H. welwitschii could replace DEET (o-chloro-N,N-dibutyl benzamide) which is inported, in the formulation of mosquito repellent Jelly or pomade which is now being marketed by some multinational companies in Nigeria. On the other hand new products such as spray-on mosquito repellent or mosquito repellent petroleum Jelly using Hemizygia welwitschii as the repellent active ingredient can be developed. These products need a parent and this parent whether individual or corporate could be you.

Keeping-pests-out-of-the-garden scenario I have just described has five components:

i. using insects that feed while developing their young ones on the pests of cowpea and enhancing the development of these natural enemies by judicious use of pesticides, Cydia ptychora has been reduced to a non-pest in Nigeria. This is a case of using one insect species to control another insect species.

ii. by identifying the secretions (pheromones) from the abdominal glands of the females which function as attractants for the males for the purpose of mating and applying these pheromones into traps at concentrations higher than what the female sawflies could produce, the male sawflies were therefore confused as they were attracted to traps which they thought were females of their own species. As offsprings could not

be produced without mating, the population of sawflies collapsed with the use of the sex attractants developed by us thus keeping sawflies out of the gardens of USA and temperate Europe. This is a case of using females of one species to control males of the same species.

iii. preparing extracts of certain plants and using down-to-earth local technology to formulate it into insecticides at the village level to control insect pests attacking crops ,livestock and man. Thus with neem extracts, grasshoppers, armyworm, leaf miners and stem borers were kept out of the cassava, maize, sorghum, and vegetable gardens. With estragole grasshoppers are killed within 24hrs. With extracts of the black pepper the cotton stainer, flea beetle and pod sucking bug were kept out of the vegetable gardens. With extracts of H. welwitschii, L. adoensis, P. guineense and common citrus (oranges) the ticks were kept off the cattle. Finally with extracts of H. welwitschii, and P. alliacea the mosquitoes were kept out of human habitation. This is a case of using plants as killing agents (botanical pesticides) to control various species of arthropods which are considered pests.

iv. by using volatile oil of P. gurineense weevils are kept out of the seed cowpea or beans. The volatile oil is non-toxic to humans but is an effective insecticide against weevils. Using such preparations the much publicized killer bean situation wouldn't have arisen in Nigeria.

v. by establishing the biochemical basis of action of phloem alkaloid ricinine, we thus created avenue for model after which future development of systemic insecticides for polyphagous insects especially the sap feeders will be made.

The scenario has thus described the use of natural products to control pests. In the coevolution of plants and herbivorous pests, many plants developed defensive secondary plant metabolites which are toxic to plant pests. Some of these secondary metabolites have

broad spectrum activities and can be extracted in commercial quantities. While urbanization and wanton desire for imported pesticides (which are toxic, cancer causing, environmentally unsafe and expensive) have made us forget some of these effective native technologies of our forefathers, perhaps one mosquito control method that is still being practiced is the burning of dry citrus peel in the homes. There is no community in Nigeria no-matter how small which does not have information on bioactive plants. Such information may not be used by the present generation but are passed on from one generation to the next by oral (and perhaps nowadays by written) traditions. Such information are passed on because they have stood the test of time. They are certainly our heritage that must be kept and developed, and not to be allowed to go into extinction like the dinosaurs and dodo birds of old.

If we cannot develop our own God-of-Nigeria given resources, they will be taken to Europe, America or Japan, refined and represented to us as God-of –Europe-(USA or Japan)-given resources. Synthetic pesticides cannot be compared with natural pesticides. Being naturally evolved ingredients of the biosphere, such plant derived products have at least a priori advantage over synthetic alien molecules in terms of ecological suitability.

Let us take the example of natural pyrethrum and the synthetic pyrethroids. First developed during World War II, the synthetic pyrethroids have been dogged by certain drawbacks, being in general limited in their range of activity. Tetramethrin, for example, knocks flies down to the ground as fast as pyrethrum, but is only half as effective at killing them, and is virtually ineffective against mosquitoes and roaches. Resmthrin, in contrast, has a good killing power against most insects, but virtually no knockdown. Bioallethrin and bioresmethrin are superior to tetramethrin and resmethrin, but still lack the all-round performance of the natural pyrethrum. A comparison can be seen from malaria fever thereapy in Nigeria. While many Nigerians will take synthetic drugs like chloroquine, Fansidar, etc, these same people will quickly prepare herbal concoctions (Yoruba: Agbo) for a more serious

attack. Double standard at play, If we know that herbal concoction can do a better job with no side effects why is it not on the shelf of a drug store as it is the case in China?

These natural products are renewable and sustainable. These natural insecticides are environmentally friendly unlike recalcitrant synthetic insecticides such as DDT whose half-life in Nigeria has been estimated to be 490-525 days (Olaifa et al. 1991c)

(h) The complementary use of the neem cake with nitrogen fertilizer has been proved in view of the fact that neem cake reduces the growth of the nitrifying bacteria. This reduces the breakdown of nitrogen from fertilizer and so optimizes the efficiency of fertilizer application.

Neem cake has thus been powdered and developed into organic fertilizer by us. Branded **NEEMFERT** this fertilizer has been introduced to farmers in Oyo state (Olaifa, 1996) and has been adopted by some farmers in Ogbomoso area.

We also found with satisfaction that I kg of neem cake cemented to the base of transplanted seedling of oilpalm Elaeis guineensis Jacq. completely deterred grasscutters Throyonomys swinderianus T. (Yoruba: Oya) and African giant rat Cricetomys gambianus Waterhouse (Yoruba: Okete) from eating the seedlings. With this development, wire collar the popular recommendation for rodent control in oilpalm which is not only expensive but ineffective becomes unnecessary.

It is gratifying that LAUTECH Farm has adopted this simple but effective technology in its oilpalm establishment.

With the establishment of Ladoke Akintola (Formerly Oyo State) University of Technology on 23rd April, 1990 and the appointment of our able Vice Chancellor Professor O.L. Oke on 2nd May, 1990, I was invited to participate in the Curriculum Drafting Committee during the months of May to August, 1990. Working with other sharp minds like Professor A.A. Adegbola Foundation Dean of the Faculty of Agricultural Sciences and

Professor Wale Omole Vice Chancellor Obafemi Awolowo University, Ile-Ife, we fashioned out our brand of agricultural curriculum where our students will be versed in the science and practice of agricultural production, protection and marketing. They are also being trained in the local production of pesticides for the control of crop and livestock pests and local production of organic fertilizer. It is a curriculum where we have economic and technological advantages. The raw materials are available with us. For the botanical pesticides and fertilizer for example, the neem tree is found right from the coast to the northern boundary of Nigeria and beyond. Lippia is found from the coast to as far north as Kaduna state but the area of greatest concentration is Niger State. Hemiziygia is available from the coast to as far north as Zaria. What of oranges and the black pepper? Both are produced in the south and shipped to the north for orange juice and pepper sauce for roasted meat "suya" respectively. When finally formulated, plastic bottles which are available in various shades and shapes in Nigeria will be used as containers. No solvent other than water is needed and their effectiveness had been proved beyond doubt (Olaifa and Adenuga 1988; Olaifa et al. 1991a, 1991d, 1993, 1994).

Based on these starling qualities of natural products, I wish to suggest for immediate consideration and implementation of the various governments in Nigeria the recommendations below which are considered the only viable option to develop our pesticide industry. Before the recommendation are listed let me describe the present situation of pesticide industry in Nigeria. We are a dumping ground for all the pesticides that are banned in E;urope, Americas, Russia, South East Asia and India. The pesticides such as DDT, Iindane (Gammalin 20), dieldrin, are still being marketed in Nigeria today by the multinational and indigenous chemical companies. There is no pesticide legislation. The legislation that was not in place is being grossly abused as deliberate misbranding, mislablling, mishandling and dumping of toxic chemicals became rampart. No chemical

company in Nigeria is manufacturing any pesticide, what they do is formulation according to imported technology or direct marketing of imported formulated pesticides. What we are saying in effect is that right now there is no indigenous pesticide, and no indigenous patenting of any active ingredient or formulation technology in Nigeria. The Nigerian bureaucrats in charge of pesticides at the state level are not helping the situation much either. For example in 1988 when the Federal Ministry of Agriculture and Natural Resources was making efforts to popularize Locust Lotion for the control of grasshoppers and locusts, many states in the north including Kwara state adopted the technology. One state in the South Western Nigeria likened Locust Lotikon to one lawyer who was handling a land case for one community. The lawyer was feeding fine from the land and would always ask the judge for more time to counsult with his clients. During the period, the lawyer's son also qualified as a lwayer. The aging lawyer asked his son (now a lawyer) to appear on his behalf in court in the age-long land case. The young lawyer succeeded in finishing the case in just one appearance. This excited young lawyer came home happily to tell his father the case was finished. The son was surprised at the reaction of his father who bullied on him saying "You killed that case?, the case that I used to train you in school, you killed it?". The bureaucrats in the state in question felt that if we got a local panacea to the problem of grasshoppers which appeared then as the major crop pest in the state, that state would be deprived of the usual allocation of imported pesticide from the Federal Government. This is short sightedness at its best as there can be no development without indigenous technology. It is therefore in the interest of Nigerian both living and unborn that I call on the various government of Nigeria to take the following recommendations seriously.

1. The Federal Government of Nigeria must establish as a matter of urgency pesticide Industry for the manufacturing of agrochemicals. With the establishment of the Fertilizer

Industry at Onne river States, the Federal Government has just supplied a major production input (Fertilizer) leaving behind a major production input (pesticides).

Botanical pesticide should be the focus of our pesticide Industry because that is where we have economic and technological advantages. The farmers can be easily organized to grow the plants of interest. The machines for extraction, kneading and formulation can be fabricated within the country and where petrol-chemical solvents are required, these are obtainable from the petroleum refineries available in Nigeria.

Kenya has done it successfully with pyrethrum. Kenya thus remains the major supplier of pyrethrum powder, pyrethrum aerosol, pyrethrum baits and pyrethrum insecticides-in the world today. These pyrethrum products are produced from the Pyrethrum Board of Kenya Factory of Nakuru in northern Kenya. Kenya is lucky to have pyrethrum plants Chysanthemum cinerariaefolium and C. coccineum; while Nigeria is lucky to have neem Azadirachta indica and other plants with toxic principles. Time has come for Nigeria to utilise the neem tree as a foreign exchange earner.

2. While the Federal government concentrates on neem, the state or Local Governments singly or in combination should establish small scale pesticide industries utilizing the following plant species:

Hemizygia welwitschii as insecticides for mosquito control and acaricides

Petiveria alliacea as insecticide with acaricidal action.

Funds for the establishment of the small scale pesticide industry using Hemizygia and Petiveria should be sourced by both the Ministry of Agriculture and Ministry of Health because of the significance of mosquito and agricultural pests control.

3. Nigeria must enact pesticide Legislation not only to protect the federal and state Pesticide Industries but also to rid the country of dangerous pesticides that have been banned elsewhere.

4. In view of the high cost of fertilizer and its production in Nigeria, there is the need to optimize the use of the available fertilizer. Neem Fert has provided an answer. The existing fertilizer manufacturing facility available either at Port Harcourt or Minna should be modified to enrich the formulation of fertilizer with neem additives. Small scale fertilizer industries based on the production of **NEEMFERT** should start at the Farm gate or village level to supplement the inorganic fertilizers.

5. The National council on agriculture should include neem in the list of national industrial crops as neem seed has started to command local and international markets.

Mr. Vice-Chancelor Sir, Kabiyesi Soun of Ogbomosoland and all the diguatories Present.

Thank you for listening.

27rd January, 1997

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