

KEYNOTE ADDRESS

Insect Science, Global Food Security and Environmental Health

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INTRODUCTION

I consider it a great honour and privilege to stand before you today to deliver this keynote address on the theme "**Insect Science, Global Food Security and Environmental Health.**" This topic presumes that man is the central focus of this tripartite relationship. Insect Science otherwise known as Entomology is the deliberate scientific study of insects with reference to their biology, ecology and economic importance so as to manipulate them to man's advantage (Lale, 2006). Scientific/Evolutionary records and all primordial religious documents have convergent opinion that insects evolved on this planet earth before man (Genesis 1:20-23; Speight et al; 1999). This submission is more true when we consider the passage in the Holy Bible, which says a thousand years is like a day or a watch in the night (Psalms 90:4; II Peter 3:8) especially from the context that objects of time measurements such as the sun and the moon were not in existence until the fourth day of creation. A significant step in the cultural

evolution of man is the development of large scale cultivation of food crops or monoculture and the capacity to store the excess crops so produced. This step resulted in the creation of artificial environment for insects and this culminated in ecological disequilibrium. Other human activities such as road construction, built-up environment and impoundment of inland waterways have led to the creation of artificial breeding sites for some insects and their intermediate hosts. Generally, all activities of man affect insects because they have thoroughly mastered the world and taken full possession of it even before man evolved, hence insects contest every human invasion into their original domain. This is possibly the genesis of food insecurity and impact of insects on environmental health.

However, inadequate water supply to crops arising from climate change is another significant reason for global food shortage.

What are insects?

Insects are small-sized hexapod invertebrates easily recognized by the possession of well defined three body regions namely; the head, thorax and the abdomen. In addition, they also have six jointed appendages, one or two pairs of wings, a pair of antennae, exoskeleton and a pair of compound eyes to mention a few.

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Insects are better known for their deleterious effects on man and his activities. At times they inflict injuries on man and his livestock through their biting and sucking activities, feed on our crops and produce, and in a number of cases they annoy us, feed on our blood or even live with us. Insects constitute about 75% of all described animal species and are well adapted to virtually all ecological habitats. These attributes coupled with their high reproductive potential, small size and ability to feed on a wide variety of food stuffs accounted for the success of this class of animals. Some of these characteristics of insects have made them relevant to virtually all human endeavours; after all they colonized this earth for at least 300 million years before the advent of man.

Economic importance of insects

Relationships between insects and man are not always adversarial. Many insect species act as food for man and his animals; some are agents of food security through their pollinating activities while others are efficient recyclers of organic matter (trash burners/ waste managers) because they aid decomposition of organic matter and soil formation. Insects and their products have a lot of uses in medicine. Cantharidin, a blistering agent obtained from blister beetles has been used for treatment of certain diseases of the urinogenital system while honey is used for dressing wounds. Knowledge of insect structure is now being used for the design of robots and micro-air-vehicles (MAVs) which can navigate places inaccessible to man (Wooten, 2000). Insects have been used to draw conclusions when investigating legal cases relating to man and wildlife (Gennard, 2007). This branch of forensic science is known as Forensic Entomology. Insects are useful as predators and parasitoids of many injurious species. All these useful attributes notwithstanding,

insects are better known for their deleterious effects on man, his crops and animals.

Insect science and global food security

Food security has been defined in different ways by various bodies and authors. According to FAO (1992), Food Security is defined as an "access by majority of people in a given community/region/country to food that is consistent with decent living and nutrition at all times." However, FAO (2008) presumed that food security can only "exist when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life." Some of the key elements of food security include food production, processing, storage, marketing, distribution, human resources, purchasing power and income distribution.

Food insecurity exists when an individual or a people are undernourished because of physical unavailability of food, lack of access to, and/or inability to utilize food effectively due to infection or disease (FMA&WR, 2008). The key factors responsible for food insecurity were summed up as high rate of population growth relative to agricultural productivity of a nation, low capacity to store excess food so produced, low capacity to purchase staples from other sources, and political instability.

The primary objective of agriculture is to produce food to feed and nourish the populace and raw materials for industries. Agriculture is the source of all foods and insects have a lot of impact on agriculture and environmental health. Therefore, insect science, global food security and environmental health are interrelated. Recently, the International Fund for Agriculture (IFAD) warned that Nigeria is vulnerable to food crisis because of its heavy dependence on food importation (The Guardian, 22 August 2011). The recent alarm

raised by IFAD has only further corroborated an earlier warning by FAO (2008) that food insecurity was most severe in sub-Saharan Africa compared to other regions of the world. In response to this crisis, Nigerian governments at various levels have been making policy statements ostensibly at reversal of this negative trend. Efforts have been made by various administrations to subsidize agricultural inputs and give micro-credits but corrupt officers in the bureaucracy may not allow these concerted efforts to yield the desired results. To abate this challenge of food insecurity, government must carry out a holistic overhaul of the agricultural sector including agronomy, inputs, transportation, mechanization, pest management, breeding, storage, research and development. Professional bodies such as the Entomological Society of Nigeria (ESN), Nigerian Society for Plant Protection (NSPP) should be key players in the proposed reform so as to abate fund leakage in this sector.

Global postharvest losses of food grains and other commodities from pests put at 5-15%, could go up to 100% for sub-Saharan Africa including Nigeria (Lale and Ofuya, 2001). Presently, Nigeria imports about 50% of its food consumption (The Guardian, 22 August 2011) possibly because of the characteristic nature of the Nigerian agriculture such as small scale farms and industries, heavy dependence on rain-fed agriculture, inadequate price incentives for farmers and marketers during the period of glut, poor quality and inadequate supply of farm inputs, inadequate infrastructure for strategic stock and finance, low level of mechanization, policy somersault on credit, subsidy, agricultural extension and marketing (Ivbijaro, 1990; Lale, 2001; FMA & WR, 2008). This situation is further exacerbated by insect pests and diseases, global warming, desertification, bush fires, poaching,

urbanization, HIV/AIDS and youth restiveness. All these factors are responsible for food insecurity in Nigeria.

Poverty, a multidimensional concept is often used interchangeably with food insecurity. However in absolute terms, poverty is a condition of insufficient or total lack of basic necessities of life including food, shelter, education, safe water and medical care. It has also been defined as the inability to attain a minimum standard of living by the World Bank (1990). Hunger, a recurrent and involuntary lack of access to food and malnutrition which is inadequate nutrition due to dietary deficiency or illness are terminologies often used in relation to food security and poverty. Food insecurity itself is an integral component of poverty.

Involvement of insects and insect science in food security are two folds. Firstly, insects could be veritable agents in ensuring food security through their pollinating activities which have a direct

effect on fruit and crop production and indirectly through cross pollination which is required for fertility and plant vigour. Insect biodiversity is a sensitive index of the health status of a habitat and their pollinating activities is a significant factor in food production especially in developing countries where artificial pollination is seldom practised. Global pollination services rendered by insects have been estimated to exceed \$100 billion annually by 2003 valuation (Gullan and Cranston, 2005). The second involvement of insects is that they could be veritable agents of food insecurity through their destructive activities on crops, man and his livestock. All stages of food production till consumption are susceptible to insect pest infestation.

Insect Science and Environmental Health

Insects are also vectors of diseases of man and his livestock. However, less than 1% of all

described species of insects are pests of crops or vectors of diseases of man and his animals. Major insect vectors of diseases in the tropics include mosquitoes, tsetse flies, black flies, biting midges, sand flies and houseflies. Detailed information on their bio-ecology is provided by Service (2008). Man has devised several techniques for combating the menace of insects that limit food security or affect human and animal health. Some of the common techniques include physical control methods such as hand picking and destruction of insects, cultural practices, crop rotation, close-season practice, hermetic storage devices. Others are biotechnical methods such as the use of resistant crop varieties, genetically modified organisms (GMOs), and solar disinfestations, insect growth regulators, pheromones and traps, plant products and extracts. Insect pest management techniques also include biological control methods such as the use of microbes, parasites, predators and pathogens to control insects; and the use of semiochemicals and synthetic chemical insecticides. The use of synthetic chemical insecticides is probably the most drastic and effective of all the techniques. However, some of the limitations of synthetic insecticides are high cost of insecticides, high mammalian toxicity, biomagnification of toxic residues in the trophic chain, persistence of residues in the environment and emergence of resistant pest strains. Other demerits include phytotoxicity, toxicity to wildlife and non-target organisms.

The use of microorganisms such as fungi and bacteria in pest management has a number of advantages such as: safety in terms of human and mammalian pathogenicity, eco-friendliness and sustainability; ingestion of spores by the host may not necessarily be a pre-requisite for infection, in some cases they also induce epizootics in several orders of insects. This control measure is amenable to cottage industrial production and requires

relatively low investment.

Some of the most serious side effects of synthetic pesticides are loss of biodiversity and destruction of predatory insects which tend to keep pest population in check. Many chemical applications also affect cattle, game and other wild and domestic animals. However, the following steps should be considered when choosing a chemical formulation in order to avoid unfavourable environmental consequences which may arise when using chemical pesticides in agro-ecosystems: The active ingredient may not be selective but the active ingredient with lower toxicity should be given preference over the one of higher toxicity. An active ingredient with the lowest possible persistence in soil should be selected and the mode of action should also be taken into consideration.

One of the most severe global problems confronting humanity today is probably the climate change. The observed change in the earth's climate is attributable to human activities. Both natural and human systems are vulnerable to this change because of their limited adaptive capacity. Geographic location, time, socio-economic and environmental conditions are some of the key factors responsible for this susceptibility. Therefore, global warming and climate change are real phenomena and their consequences cannot be overlooked with a wave of the hand. A major casualty of global climate change is food supply because anthropogenically induced climate change secondary to increasing levels of greenhouse gases would likely have a profound effect on agricultural production. Agriculture is strongly dependent on availability of water. Unlike the situation in developed economies where water for agriculture is greatly supplemented by irrigation, most farmers in the sub Saharan region depend on rain-fed Agriculture. Climate change has started

modifying rainfall patterns, evaporation, run-offs and soil moisture storage which in turn may trigger off food insecurity. This may also trigger off pest migration or pest population explosions which may significantly affect agricultural productivity, profitability and sustainability. It has also been estimated that for every one degree Celsius rise in temperature crop yields drop by about 3-5% while there is a rapid change in the distribution of plants, insects, animals and even soil bacteria. It is clearly evident that climate change may lead to increase in pest populations (i.e. insects, weeds, invasive species and insect-borne diseases) which may also increase the use of pesticides and/or other pest management options. This may in turn affect the environmental health. The epidemiology of plant and animal diseases may be altered and prediction of pest and disease outbreaks may be more difficult because of weather instability and changing climate. This environmental instability may affect the effectiveness of pesticides on target and non-target organisms while biological control agents may be positively or negatively affected.

Concluding remarks

Insects have been impacting, both positively and negatively, on global food security and environmental health of man with the scale shifting more to the negative side. This is understandable because they make similar nutritional demands on the environment and have existed on earth long before man. Man has deployed his intellect to subdue them but with little success. Virtually all pesticides invented by man to subdue insects are also toxic to man. The discovery of DDT by Nobel laureate Paul Müller in 1948 only brought a temporary setback to insects. It was long after this breakthrough that DDT residues were found in fish and birds that ate the poisoned fish. This led to aggressive and sustained

campaign against its use by environmentalists spear headed by Rachel Carlson in her book entitled 'silent spring' in 1962 which eventually led to the banning of use of DDT. Okiwelu (2011) in his valedictory lecture observed that it was an irony that Rachel Carlson who saved humanity from pending destruction arising from the use of DDT was not awarded a Nobel Peace Prize. However, it is heartwarming to note that Wangari Maathai, the first African female recipient of Nobel Peace Prize in 2004 got the award for combining environmentalism and social activism (The Nation,, September 27, 2011). She was the founder of the Green Belt Movement that started tree – planting campaign in Kenya. Maathai's idea was also the inspiration behind the United Nations Environmental Programme's (UNEP's) Billion Tree Campaign launched in 2006 and for which 11 billion trees have been planted to date. Reports on food poisoning emanating from meals of beans or yam flour protected with insecticides are common occurrence on pages of Nigerian newspapers. To abate the challenges of food insecurity and environmental mismanagement, paramount among things to be put in place are:

- * Research in all facets of agriculture leading to development of new technologies should be stepped up so as to increase food output and income.
- * To achieve this goal, multidisciplinary and need-driven researches in our tertiary institutions and research institutes must be encouraged. In other words, research in developing nations must extend its frontiers beyond researches for mere scholarship and promotion exercises to need-driven investigations between industries and the Universities.
- * Government and industries must devote a sizeable proportion of their revenue/profit to need-driven

research.

- * There is the urgent need to develop ecologically sound approaches to insect pest management such that the use of synthetic chemical pesticides would be reduced and to this end Integrated Pest Management (IPM) is being suggested.
 - * Concerns by environmentalists on the adverse effects of pollutants on human health and welfare and habitat degradation on biodiversity have led to evolution of new disciplines such as Environmental Science, Environmental Technology, Environmental Biogeochemistry, Environmental Ethics, Environmental Economics and Ecological Economics to mention a few. Our Universities should review their academic curricula along this global trend.
 - * Food production in Nigeria should be taken to the next level by embarking on large-scale mechanized farming that is less dependent on rain-fed agriculture.
 - * Finally, tree planting should be an integral aspect of our rural and urban development in order to conserve the sanctity and purity of our environment and according to Okiwelu (2011), let each of us reduce our carbon footprint to make this earth a better place for humanity.
- Ladies and gentlemen, I thank you for your attention.

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