



## THE NIGERIAN CHALLENGE, BENEFITS AND APPLICABILITY OF BIOPESTICIDES: A REVIEW

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### ABSTRACT

Farmers in Nigeria rely heavily on pesticides for the control of various weeds, insect pests and pathogens, leading to the high importation of these products. Although synthetic chemical pesticides can be used to control some pests economically, rapidly and effectively; most of them cause serious negative impacts to the ecosystem. Nigeria's drive to boost food security and to fight insect pests and yield-limiting crop pathogens has led to certain unintended consequences. This paper highlights the need to improve the sustainability of the use of plant and environment. This can be achieved by integrating existing plant protection measures (chemical, mechanical, physical, biological, host-plant resistance, use of pheromones, cultural, etc.) under the framework of what is termed Integrated Pest Management (IPM) while identifying, advocating for and promoting the use of botanical pesticides (biopesticides) in the pest management process and also suggestion are being given to both individual and governments on how to harness the benefits of biopesticides and protect the environment.

**Key words:** Plant protection, persistent organic pollutant, sustainable use, integrated pest management (IPM)

### 1. INTRODUCTION

Pesticides are substances meant for attracting, seducing, destroying, or mitigating any pest. They are a class of biocide. The most common use of pesticides is as plant protection products (also known as crop protection products), which in general protect plants from damaging influences such as weeds, plant diseases or insects. This use of pesticides is so common that the term *pesticide* is often treated as synonymous with *plant protection product*, although it is in fact a broader term, as pesticides are also used for non-agricultural purposes. The term pesticide includes all of the following: herbicide, insecticide, insect growth regulator, nematocide, termiticide, molluscicide, piscicide, avicide, rodenticide, predacide, bactericide, insect repellent, animal repellent, fungicide, disinfectant (antimicrobial), and sanitizer. It is hearty to observe the growing awareness among the farmers and policy makers about ecologically sustainable methods of pest management. More and more farmers are coming to realize the short-term benefits and long-term positive effects of the use of bioagents and other ecologically safe methods to tackle pests. (Nirakar, 2007).

Biopesticides derived from such natural materials as animals, plants, bacteria, and certain minerals. Fungi such as *Beauveria* sp., bacteria such as *Bacillus* sp., neem extract and pheromones. Similarly Canola oil and baking soda have pesticide applications and are considered as biopesticides. The use of these materials is widespread with applications to foliage, turf, soil, or other environments of the target insect pests. In a much simpler way we can say that these are pest management tools that are based on beneficial microorganisms (bacteria, viruses, fungi and protozoa), beneficial nematodes or other safe, biologically based active ingredients. Benefits of biopesticides include effective control of insects, plant diseases and weeds, as well as human and environmental safety. Biopesticides also play an important role in providing pest management tools in areas where pesticide resistance, niche markets and environmental concerns limit the use of chemical pesticide products. (Orounye *et.al.*, 2010). Nigeria's drive to boost food security, fight insect pests and yield-limiting crop pathogens has led to the build-up of obsolete and toxic pesticides and chemicals (Schwab *et al.*, 1995). Several thousand tons of pesticides and other heavily contaminated materials have accumulated over the years, while inadequate legislation and lax regulations have exacerbated the problem (Lale, 2002). In general,

plant insect pests, diseases and weeds impose a serious threat to crop production in Nigeria. Population of weeds, insect pests and diseases have increased over the years especially by the introduction of monoculture farming in the country (Emosairue and Ubana, 1998).

Traditionally, Nigerian farmers have been relying heavily on pesticides for the control of various weeds, insect pests and diseases. Owing to recent intervention in agriculture by government, they pesticides has becoming readily available and cheap leading to over usage, Resulting in excess toxins been left in various products consumed by man leading to severe toxicity. (Nwanze, 1991; Schwab et al., 1995; Van den Berg and Nur, 1998; Okrikata and Anaso, 2008b). These have created the need for alternatives to synthetic pesticides. But inadequate infrastructure for research and extension remains a constraint to the advancement and continuity of such important activity in the country (Bugaje *et al.*, 2007).

Although synthetic pesticides can be used to control some pests economically, rapidly and effectively; most of them cause serious negative impacts, such as toxicity and residual effects to humans, target plants, foods and other living things; induction of insect/pathogen resistance resulting to ineffectiveness of pesticides; harmful effects to non-target beneficial organisms and unbalanced ecosystem due to pollution of soil, water and environment (Deedat, 1994; Gupta and Shyam, 1996)

The challenge to sustainable use of plant protection products is a long-term one. It involves helping farmers to properly control/manage pests in such a way that they do not only minimize immediate risks from dangerous pesticides but also reduce the possibility of accumulating future stocks. Synthetic pesticides pose a threat to sustainable development. The adverse impact of persistent organic pollutants, or POPs as many of the pesticides are known, on the environment and health are serious. POPs do not degrade easily, but remain intact in the environment for a long period of time. The pollutants disperse easily

across wide geographic areas, retain their toxicity and have a tendency to accumulate in the fatty tissues of organisms (FAO, 2007).

Human health and environmental safety are the two most important issues in the long-term application of pesticides. Therefore, the reduction in the amount of pesticides used in agricultural production has been a major issue to environmentalist. In order to maintain the balance of the ecosystem based on the conservation of natural resources and minimization of harmful effects to the environment; measures other than chemical control for pest management are seriously considered. These measures could partially replace and minimize the risk of using synthetic pesticides to meet the requirement of organic farming in Nigeria.

Laboratory and field research in Nigeria have proved that botanicals could be economically feasible, technically effective and environmentally friendly alternatives to synthetic pesticides. Yusuf *et al.* (1998) observed that powders of leaves of *Azadiracta indica*, *Melia azaderach*, *Zingiber officinale*, *Eucalyptus camaldulensis*, *Ocimum basilicum*, *Capsicum frutescens* and wood ash of *Khaya senegalensis* are effective in the control of maize weevil (*Sitophilus zeamais*) in stored maize. Abdul-azeez (2009) applied cashew nut shell extract on cowpea pods infested with aphids and reported that the treatment has insecticidal effects on aphids. Insecticidal activity of some Nigerian plants such as *Eugenia aromatica*, *Piper umbellatum*, *Erythrophleum guineense*, *Aframomum melegueta*, *Hyptis suaveolens*, *Allium cepa*, *Carica papaya*, *Uvaria afzelli* and *Vernonia amygdalina* against maize weevil was reported by Lajide *et al.*, (1998).

Okrikata and Anaso (2008a) observed that different formulations of neem seed kernel powder was effective in controlling *Sesamia calamistis* in sorghum. Lale and Yusuf (2001) reported the efficacy of *Piper guineens* seed oil in controlling *Tribolium castaneum* in stored millet seed. Anaso (1999) reported the efficacy of

neem kernel oil in controlling the pest complex of okro. Therefore, the aim of this paper is to highlight the need to improve the sustainability of the use of plant protection products in Nigeria with special emphasis on the use and integration of botanicals in the pest management system to help protect our ecosystem.

## 2. ADVANTAGES OF USING BIOPESTICIDES

25 million cases of acute occupational pesticide poisoning in developing countries are being reported each year (Chauhan *et al.*, 2006). 14% of all known occupational injuries and 10% of all fatal injuries are caused by pesticides (Chauhan *et al.*, 2006). Obsolete pesticides are stored in developing countries-20,000 tones in Africa alone. Pesticide residues in agricultural commodities are being the issue of major concern besides their harmful effect upon human life, wild life and other flora and fauna. Given the rate of increase in human health related problems such as cancer, genetic disturbances and damage to the immune system are caused in part by some of the toxic substances contained in pesticides (Deedat, 1994; Ermel *et al.*, 2002),

There is need for the Nigerian government to strategize and consider the effective regulation of these plant protection products. Research findings in Nigeria and other parts of the world prove that integrating botanical pesticides in our pest management system will promote safer agricultural practice.

In Nigeria, botanical insecticides have been extracted from various plants including neem (*Azadiracta indica*), Pyrethrum (*Chrysanthemum cinarariaefolium*), Tobacco (*Nicotiana tabacum*), Derris (*Derris elliptica*), Pawpaw (*Carica papaya*), Tomato (*Lycopersicon esculentum*), Cashew nut (*Anacardium occidentale*), Garlic (*Allium sativum*), Aligator pepper (*Aframomum melegueta*), Curry leaves (*Hyptis suaveolens*), Onions (*Allium cepa*), Basil (*Ocimum basilicum*), Bitter gourd (*Momordica charatia*), Ginger (*Zinigiber officinale*), Bitter leaf (*Vernonia amygdalina*), Siam weed (*Chromolaena odorata*), and pepper fruit (*Uvaria afzelli*). Their biological properties have

been tested and found to include insecticidal and repellent effects against insect pests. Some have also been found to have antifeedant, growth regulatory, oviposition inhibitory, sterility inducing, antifungal and nematicidal properties (Lajide *et al.*, 1998; Anaso, 1999; Abdul-azeez, 2009).

On the basis of chemical fingerprinting through modern equipments like HPLC, it has also been found that the urine of cows are highly effective and almost nil or few medicinal properties are present in the urine of crossbred, exotic cows, buffaloes, etc. The Indigenous cow urine contains immune modulators which is responsible to modulate immune system and act as bioenhancer. It is not only the cow urine which is a wonder product but other products like dung, milk and curd are also equally effective in various ailments. Cow urine as such and/or after addition of neem leaves is a wonderful biopesticide or pest repellent. Such biopesticides are safe to use, do not accumulate in the food chain and as such do not have the harmful effects like chemical pesticides. Cow dung is an excellent farm yard manure and if processed and prepared vermin compost; very small amount of vermi-compost is sufficient for a large field. Similarly, many medicines are prepared from the cow milk, ghee and curd. However, again the problem is same, scientific validation of these products is required. The ability of indigenous cow urine is tested for its immunomodulatory properties in mice, rat and avian lymphocyte cell culture system (Chauhan *et al.*, 2006; Oruonye, 2010)

The foregoing evidence indicates that Nigeria is ripe in harnessing this botanical potentials and utilizing such for our benefits because biopesticides has the following specific advantages,

(a) Biopesticides are best alternatives to conventional pesticides and usually inherently less Toxic than conventional pesticides. (Nirakar, 2007)

(b) Biopesticides generally affect only the target pest and closely related organisms, in contrast to

broad spectrum, conventional pesticides that may affect organisms as birds, insects, and mammals. (Nirakar, 2007)

(c) Biopesticides often are effective in very small quantities and often decompose quickly, thereby resulting in lower exposures and largely avoiding the pollution problems caused by conventional pesticides. (Chauhaun *et al.*, 2006)

(d) When used as a fundamental component of Integrated Pest Management (IPM) programs, biopesticides can greatly decrease the use of conventional pesticides, while crop yields remain high. (Nirakar, 2007)

(e) Biopesticides are amenable to small-scale, local production in developing countries and products available in small, niche markets that are typically unaddressed by large agrochemical companies. (Oruonye, 2010)

### 3. APPLICABILITY

It is important to be careful when using any pesticide (organic, natural or biopesticidal). Even if this product is considered to be organic in origin, it is still a pesticide. Just because a product is thought to be organic, or natural, does not mean it may not be toxic. While some organic pesticides may be nontoxic or are only slightly toxic to people, they may be very toxic to other animals. For instance, the organic pesticide Ryania (trade name) is very toxic to fish. Also, some organic pesticides may be toxic to beneficial insects, such as honeybees. The use of an Integrated Pest Management Program (IPM) is important to ensure success. The scope of IPM from region to region varies, but for Nigeria as a region certain IPM measures are achievable at various levels.

#### 3.1 GOVERNMENT LEVEL

1. The farmers should be advised about the harmful effects of pesticides so that they should minimize the use of pesticides in crops. They should judiciously use the pesticide in terms of their quantity and frequency.

2. All emphasis must be laid on the development of Bio-pesticides like viral, bacterial or fungal pesticides or pesticides of botanical origin like Neem or Tulsi or of cow urine based pesticides, which can be used in crops to kill the insect pests without polluting the environment.

3. The harmful pesticides like some organochlorines, organophosphates and carbamates must be banned strictly in Nigeria: production, import or use of such pesticides must be stopped.

#### 3.2 HOUSEHOLD LEVEL/INDIVIDUAL LEVEL

1. Avoid the use of chemical pesticides in house such as mosquito repellents, cockroach killers, sprays, mats, coils, etc. All of them are harmful to the body and responsible for making body susceptible to various kinds of ailments (Chauhan and Singh, 2001).

2. Avoid the use of synthetic chemicals, dyes, flavoring agents, preservatives, antifungal and antibacterial agents in food items due to fear of assimilating pesticides residues. (Khurana *et al.*, 1999)

3. Use fresh foods as far as possible after proper cleaning. Vegetables should be kept in lukewarm water with 0.89% salt for at least 30 min before use.

4. Avoid the shining vegetables fruits such as tomatoes, apple, cucumbers etc, because just simple washing do not remove the petroleum based wax used in the process as well as any bacteria trapped under the shells. Endeavour to have such vegetables/fruits/cereals/pulses which are grown under organic farming methods. (Luster, 2007).

### 4. CONCLUSION

The key to attaining food sufficiency in Nigeria is ensuring that crops stay healthy and protected from damages by pests and diseases. In order to permanently maintain the productivity, ability to function, regenerative power and the buffering capacity of the open system within which plants are cultivated, plant protection measures must

be generally acceptable, economically feasible, technically effective, environmentally friendly and easy to use or apply. National pesticide programmes have various goals, most of which can be met by an effective legal framework. The need to ensure the efficacy of pesticide products for their proposed use, while at the same time protecting pesticide users, consumers, crops, livestock and the environment cannot be overemphasized. In this regard, the importance of recruiting botanicals in plant protection or pest control is imperative. This paper recommends the need to launch a nationwide effort to clean up these harmful chemicals, prevent future accumulations, promote safe-handling techniques by working directly with farmers and strengthen the country's institutional capacities to tackle the issue.

Finally, the importance of food sufficiency, agricultural policy makers in Nigeria should advocate for a revision of the laws to facilitate the effective supervision of pesticide quality and monitoring of residues due to the use of agricultural chemicals. Adequate funding of researches in crop protection which amidst others is geared toward discovering botanical pesticides is also indispensable.

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