

# PHYSIC NUT (*Jatropha Curcas*) EXTRACTS AS VIABLE BIO-PESTICIDES IN GRAIN STORAGE FOR GREENING THE ENVIRONMENT.

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## Abstract

*In recent times, the need to control pests through economic and eco-friendly ways have given rise to the investigation of pesticides of natural sources, especially those of plant origin with the aim of greening the environment by reducing harmful residues during pest control. Some of the plants of interest have bioactive compounds that are insecticidal to some insects, thus offering protection against grain-crop damages. The interest in the use of physic nut (*Jatropha curcas*) as a biopesticide against weevil attack on grains is based on its benefits such as being widely available and cultivatable, costfriendly, target specific, safe to non-target organism and the need to replace the use of synthetic pesticides in controlling insect-pests of grain-crops with eco-friendly alternative. However, bio-pesticides usage in Nigeria and some nations has not been given serious consideration as a means of pest control while focusing on greening the environment. The study discussed challenges synthetic pesticides present, bio-pesticides as means of greening the environment, the advantages physic nut offers as a bio-pesticide, and method of preparing physic nut seed powder as bio-pesticide. Recommendations were made in line with the discussion.*

**Keywords:** *Physic nut, Pest control, Synthetic pesticide, Bio-pesticide, Greening environment*

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## Introduction

Occurrence of insect-pests constitutes a major problem in agriculture and economy leading to enormous food shortage in tropical and sub-tropical countries of the world. It was estimated that over 20,000 species of field and storage pests, such as bean weevil (*Callosobruchus maculatus*), angoumois grain moth (*Sitotroga cerealella*), rice weevil (*Sitophilus oryzae*), maize weevil (*Sitophilus zeamais*) and other granary weevils destroy approximately onethird of the world's food production, among which the highest losses (over 43% potential production) occur in developing countries, such as Africa and Asia (Ogu, 2014). During infestation, the seeds or grains serve as the host accommodating the pests for their lifespan while they feed on the contents of their host, leaving behind round holes in the produce. The feeding on the host results to substantial quantitative and qualitative losses manifested by seed perforation leading to reduction in weight, market value and germination viability of the seeds (Oluwafemi, 2012).

In order to curb or reduce losses experienced during farm produce storage, many farmers, businessmen and households resorted to the use of various synthetic pesticides as a way of controlling insectpests of farm produce due to their effectiveness when applied. According to Adams (2007), insect-pests of stored produce can be controlled through fumigation. Also, Săpunaru, Filipescu, Georgescu and Bild (2003), stated that to control insect-pests of stored crops, grains must be stored at moisture content of 12%, in well-closed places/ containers, disinfected with solutions carbetox 37 CE, nogos 50 CE or thermal aerosols with diclorvos or pirimifosetil as pesticides. Observations of the researchers showed that majority of the methods of controlling insectpests focus on the use of synthetic chemicals which are detrimental to health and environment. Jide-Ojo, Gungula and Ojo (2013), Umar (2014) and Longe (2016) noted that pests control using synthetic chemicals such as Aluminum phosphide, Gammalin and Pirimiphos-methyl (Actellic) have also been extensively used in Nigeria as a common practice of insect-pests control. It is reported that about 125,000 - 130,000 metric tonnes of such chemicals are used annually in Nigeria (Adegbola, Bamishaiye, & Olayemi, 2011), and about 6,000 US Dollars is spent annually in purchasing synthetic pesticides against grain storage weevil (Amita, 2007). Hence the paper discussed challenges of chemical pesticides, greening the environment, the advantages physic nuts, and method of preparing physic nut seed powder as bio-pesticide.

## Synthetic Pesticides and their Challenges

Synthetic pesticides are substances prepared and used

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widely for killing or controlling the activities of harmful insects that are of economic importance to agricultural produce. According to Karerus, Rotich and Maina (2013), synthetic pesticides are toxic

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substances prepared artificially for killing or controlling pest infestation in the field or store. Synthetic pesticides are associated with many challenges which include insect resistance against the pesticides after some period of usage, pest resurgence, residual toxicity, increasing cost of production, widespread of environmental and health hazards (Ogbaji & Osuman, 2011). It therefore, means that the harmful effects of synthetic pesticides are not limited to insects only but extends to human beings; either from direct contact or as residue in food and the environment. Humans have suffered different degrees of illnesses from food poisoning caused by the use of synthetic pesticides. synthetic pesticides are also harmful to the environment due to the presence of toxic DDT (Dichloro-diphenyltrichloroethane) – a widespread chemical which has been banned in many countries due to its accumulation in fatty tissues (Benjamin, William, Elvis & Peter, 2012).

In Nigeria, there are different reports indicating cases of food poisoning as a result of unguided, wrong or constant usage of synthetic pesticides. Notably, Inalegwu (2008, May), reported that 120 students of a secondary school in Doma, Akko Local Government Area of Gombe State became sick after eating food contaminated with synthetic pesticides. The author further reported that, 112 people were hospitalized while two lost their lives after eating beans preserved with synthetic pesticides in Bekwara Local Government Area of Cross River State.

Due to the adverse effects of synthetic pesticides on human health and the environment, the use of these synthetic pesticides have been banned in many countries including Nigeria (Ntow & Botwe, 2011). The National Agency for Food and Drug Administration and Control (NAFDAC) banned the sale and supply of about 30 synthetic pesticides which pose harm to humans and the environment in the country (Inalegwu, 2008). Despite the ban, many individuals for the purpose of preserving stored food produce continually use such synthetic pesticides indiscriminately. The indiscriminate application of synthetic pesticides on agricultural produce has reduced many Nigerians from consuming grains for fear of unknown. Nigerian beans was banned by European Union (EU) between June, 2015 and June, 2016, and which was later extended to 2019 for further regulation; on the ground that the produce contains high concentration of synthetic pesticides harmful to human health and the environment (Premium, 2016, June). Due to these associated flaws of synthetic pesticides usage, there is a need to consider the use of organic/plant extract that is biodegradable, safe, cheap, and readily available and devoid of bio-accumulation in the system of humans and animals, and which can be used as a better method of greening the environment.

### **Greening the Environment**

Greening the environment aims at conserving the natural resources, such as land, water bodies, and forests to have an improved living condition of both living and nonliving organisms. Greening the

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environment in this paper refers to the act of ensuring a healthy and eco-friendly surroundings through the use of bio-pesticides such as physic nut in the control of pests in order to reduce or exterminate the associated health problems. According to UNEP/ILO/IOE/ITUC (2008), greening the environment is the task of agriculture, manufacturing organisations, research institutes, administrations, and service centers that contribute substantially to preserving or restoring environmental quality with the objectives of protecting the ecosystems and biodiversity, reduce energy, materials, and water consumption, de-carbonize the economy, and minimize generation of all forms of waste and pollution that affect human and animal health. Greening the environment, are activities that protect ambient air and climate, waste water management, waste management, soil, ground and surface water, noise and vibration abatement, biodiversity and landscape in addition to encouraging organic farming, (Eurostat, 2009). Greening the environment has certain benefits to both rural and urban dwellers, communities and society as indicated by Ghanshyam (2015).

### **Benefits of Greening the Communities and Societies**

In greening the environment, the bio-pesticidal properties of physic nut cannot be overemphasized. The potentials of physic nut, especially in the possession of bioactive compounds indicates its possibility of effective pest control, thus could serve as a better option for managing storage pests without resultant/residual side effects on both the farm produce and the consumers. The outcome of the biopesticidal potentials of the plant is consequential to greening the environment.

Through sustainable chemistry, which is a philosophy of chemical research and engineering that encourages the design of products and processes that minimize the use and generation of hazardous substances, the extracts of physic nut such as its seeds powder can be prepared or manufactured industrially to combat the activities of weevils in grain storage, instead of the application of synthetic pesticides which are hazardous to man and his environment. In 1990, the Pollution Prevention Act was passed in the United States to help create some modus operandi for dealing with pollution in an original and innovative way. The act aims at guarding against problems associated with environmental pollution before they occur. Thus, the use of biopesticides could be a business outfit for chemists as they could help in the extraction of the bio-pesticide contents for storage of grains to guard against weevils. The extraction can be made possible green nanotechnology.

Green nanotechnology refers to the application of green chemistry and green engineering principles in the manipulation of materials at the scale of the nanometer for healthy purpose of users and the environment, serves Some scientists believe that mastery of green chemistry and green engineering principles could help transform the ways of manufacturing product for other usage. It therefore, means

that manufacturing physic nut extract as a biopesticide for grain storage could be of benefit to humans and their environment.

### **The Use of Plant Extracts as Bio-Pesticides**

Plant extracts contain pest control properties which when formulated and applied appropriately combat the activities of insect-pests both in the field and in store. According to Esimone, Nworu and Jackson (2009), plant extracts that are used in preservation of stored products against insect-pests are obtained from different parts of plants such as the seeds, leaves, roots, flowers, barks, fruits, or a combination of the parts. These extracts are often produced as powders, oils and solution, as the active ingredient of the plants are toxic to selected insects. Many of the plant extracts have been used in varieties of ways as bio-pesticides in homes, in commercial and as well as in subsistence agriculture by small-scale farmers (Karerus, et al., 2013). The total world production of bio-pesticides is over 3,000 metric tonnes/year (Suman & Dikshit, 2010). The plants extracts are effective against a wide range of insect-pests, many of which cannot be successfully controlled by synthetic pesticides. Unlike synthetic pesticides, natural compounds are relatively non-hazardous to human beings, mammals, and the eco-system. Plants derived insecticidal compounds control insect-pests either by killing or preventing them from destructive behaviour by interfering with their physiology, nervous system, acting as anti-feedants and impeding the normal development of insects-pest (Amita, 2007). Other ways in which the bio-pesticides combat the activities of insect-pests can be through direct contact, stomach poisons or act as respiratory inhibitors (Ogu, 2014). Some of the bio-pesticides are not very selective in controlling insect-pests because their target range is broad (Karerus *et al.*, 2013). The plant extracts used in preparing pesticides are mostly available in our surroundings thereby making it less difficult to access or purchase.

The use of botanical (plant) extracts is gaining more importance in controlling crop pests due to the low cost, environmentally friendly and bio-degradability. Besides the aforementioned importance of botanical extracts, they are also easy to prepare and apply. It is as a result of these that naturally occurring pesticidal properties in plant products have become of immense concern in preserving agricultural produce against insect-pests for many years in some part of the world, Nigeria inclusive. Some of these plants have both medicinal and aromatic properties that in addition to safe keeping of stored foods add flavour. The chemical repellency ability of the botanical plants was as a result of the scents that repel weevils by disrupting their ability to locate or feed on the host (Vinayaka et al., 2010). Most of the plants that their extracts are used as bio-pesticides contain bioactive compounds such as simple alkaloids (nicotine, anabasin), complex esters (pyrethrins), heterocyclic aromatic compounds (rotenoids), steroids (phytoecdysones), and possess bio-pesticidal properties in their bioactive components (Amita, 2007). Due to paucity of documented information on the efficacy of physic nut (*Jatropha curcas*) in controlling insect-pests in the storage of grains, the extracts of the plant (physic nut) is of concern in this paper.

The physic nut (*Jatropha curcas*) which is commonly known as lapalapa, ubobollochi and binidazugu in Yoruba, Igbo, and Hausa respectively is a short-lived perennial shrub. Physic nut is a member of the family, Euphorbiaceae, which measures at about 0.5 - 2m in height and 1 - 3cm in basal diameter (Igbokwe, 2008). It is a large drought-resistant multipurpose plant which is widely cultivated in the tropics and used as pens and fence. The plant originated from Central America (Heller, as cited in Omotoso, 2014). Physic nut has many nutritional and medicinal values in treating varieties of illnesses (Ekundayo and Ekekwe, 2013). On the account of its medicinal value, Thomas, Sah and Sharma (2008), stated that the latex of physic nut contains alkaloids such as jatrophine, curcain and jatropham which are anticancerous. Similarly, Islam, Yaakob and Anuar (2011), stated that any parts of the physic nut plant like leaves, bark, seeds, sap and root can be used as traditional medicine for treatment of various ailments such as gonorrhoea, fever, skin infections and jaundice. On a similar note, *J. curcas* extracts have been reported to be effective in wound healing in rats (Esimone et al., 2009). Besides its medicinal values, the plant as reported by (Islam, et al., 2011) also serves as food. The authors further stated that the cake made from the seeds can be a good protein source for both human and livestock, and it is valuable as organic manure since its nitrogen content is similar to that of the seed cake of castor bean and poultry manure.

Physic nut contains some bioactive compounds, such as tannin, phlobatanin, cardiac glycosides, anthraquinones, saponins, steroids, terpenoids, flavoids, and phobol ester (Constance, Daniel & Opeolu, 2013; Ahuchaogu, Ojiako & Kabeh, 2014). Some of the bioactive compounds of physic nut have been reported to be present in some other plant materials used over the years for the protection of stored grains against insect-pests' infestation. Plant extracts such as seeds extract of *Azadirachta indica*, dichloromethane extract of *Acorus calamus*, methanol extracts of *Cassia siamia*, powdered leaves extracts of *Vitex negundo*, plant lectins derived from *Cicer arietinum*, peels of *Citrus sinensis*, fruits of *Capsicum frutescens*, seeds of *Piper guineens*, bulb of *Allium sativum*, stem of *Cymbopogon citrates* Staph, bulb of *Allium cepa*, leaves of *Nicotiana tabacum* were reported to be effective in combating insect-pests of grains produce (Adebowale & Adedire, 2006; Govindan & JeyarajanNelson, 2008; Onu, Ogu & Ikehi, 2015; Suleiman & Yusuf, 2011; Sadeghi, Van damme, Peumans, & Smagghe, 2006). These similarities in bioactive compound composition of physic nut and other plants deems it fit as a better option for managing pest infestation of stored grain produce without resultant side effect on the produce, consumers and the environment.

### **Method of Preparing Physic Nut Seed Powder as Bio-Pesticide**

The physic nut (*Jatropha curcas*) seeds are obtained from the plant in surrounding environment. To avoid poisoning of any kind, the ripe fruit of the physic nut, which have greenish-yellow colour are to be used, and they are to be plucked directly from the plant and dehisced by cracking to remove the kernel

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and airdried under room-temperature to avoid photo degradation of bioactive compounds by ultra-violet rays. The seeds of physic nut are subject to photochemical degradation (Salako, 2008; Karerus, Rotich & Maina, 2013). Grinding machine (electric blender) which is more preferable is used to grind the air-dried seed extract of the plant into fine powder and sieved with a 10 mm sieve. The fine seed powder is then kept in air-tight container and stored in a cool and dry place until when needed for application on grains.

## Conclusion

To ensure continuous supply of quality agricultural produce, such as seeds and grains, they have to be adequately cultivated, harvested and stored to prevent infestation by insect-pests which would lead to wastage and quality reduction. To achieve adequate storage, storage facilities are used to store farm produce which could be bulk or medium storage facilities. Although, despite the uses of storage facilities, farm produce continuously lost value to insect-pests leading to the use of conventional method of pest control – synthetic pesticides. The most commonly used method of pest control is synthetic pesticides which are hazardous to human beings, livestock, environment, the risk of developing insect resistance and high cost-benefit ratio. These flaws have instigated many researchers to find alternative pesticides to the conventional insecticides used in controlling pests of grains. They have concentrated their efforts of research to bioactive products from plants as alternative to synthetic pesticides. Physic nut (*Jatropha curcas*), possessing insecticidal properties can serve effectively as a viable option for storage pest control in grain produce when adequately explored. Therefore, apart from its uses as medicine and food for man and livestock, if its extracts are prepared and formulated into powder for example, it can be used as a bio-pesticide for preserving stored grains against pests.

## Recommendation

This paper recommended that:

- i. The effectiveness of insecticidal properties of physic nut be explored by researchers in the field of Agriculture by conducting a research to identify and isolate bioactive compounds contain in the plant extract that serve as bio-pesticides,
- ii. The seed powder of the plant extract should be incorporated into grain preservation practice of the farmers to determine its effectiveness,
- iii. Research should be conducted to investigate the shelf-life of the powders or oils of physic nut extracts to find out if repeated application is required after a given period,
- iv. Institutes of Agriculture and Faculties of Agriculture in higher institutions should conduct research into probable agronomic practices aimed at the domestication of physic nut.

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