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A review on bio-pesticide for organic farming

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Abstract
Bio-pesticides are several types of pest management intervention: through predatory, parasitic, or chemical relationships. The term has been associated historically with biological control and by implication the manipulation of living organisms. They are obtained from organisms including plants, bacteria, fungi and nematodes, *etc.* by synthetic methods. In this aspect, Azadirachtin, Methyl Eugenol, Parietin and Lantadene are the some bio-pesticides for better organic farming. They are applied in environmentally friendly way. This article provides the brief assessment to know the bio-pesticide benefits through organic farming.

Keywords: bio-pesticide, organic farming, Azadirachtin, methyl eugenol, parietin and lantadene

1. Introduction
The indiscriminate use of synthetic pesticides has resulted in ecological and health hazards along with development of resistance in insect pests. This has led to the popularity of pest control agents derived from plants as they are biodegradable, environmentally compatible and less toxic to non-target organisms. Bio-pesticides are naturally occurring substances that control pests, microorganisms and pesticide substances produced by plant containing materials. They are often important components of integrated pest management programs, and have received much practical attention as substitutes to synthetic chemical plant protection products [1]. The plant products or natural products are the substance produced by life [2]. Natural products can also be prepared by chemical synthesis and have played a central role in the development of the field of organic chemistry by providing challenging synthetic targets. The term natural product has also been extended for commercial purposes to refer to cosmetics, dietary supplements, foods and pesticide produced from natural sources without added artificial ingredients [3]. Natural products sometimes have therapeutic benefit as traditional medicines for treating diseases, yielding knowledge to derive active components as lead compounds for drug discovery [4]. In this context, organic farming continues an integrated farming system that strives for sustainability, the enhancement of soil fertility and biological diversity whilst, with rare exceptions, prohibiting synthetic pesticides, antibiotics, synthetic fertilizers, genetically modified organisms, and growth hormones [5]. It relies on fertilizers of organic origin such as compost manure, green manure, and bone meal and places emphasis on techniques such as crop rotation and companion planting [6]. Biological pest control, mixed cropping and the fostering of insect predators are encouraged. In general, organic standards are designed to allow the use of naturally occurring substances while prohibiting or strictly limiting synthetic substances [7]. For instance, naturally occurring pesticides such as pyrethrin and rotenone are permitted, while synthetic fertilizers and pesticides are generally prohibited [8]. Genetically modified organisms, nanomaterials, human sewage sludge, plant growth regulators, hormones, and antibiotic use in livestock husbandry are prohibited [8]. Reasons for advocation of organic farming include advantages in sustainability, openness, self-sufficiency, independence [9], health, food security, and food safety. The natural sources like Neem (*Azadirachta indica* A. Juss), belonging to Meliaceae family, leads the list of plants with the highest potential for this purpose [10]. Neem contains several biologically active chemicals called limonoids such as azadirachtin, nimbin, salannin, azadirachtol, nimbidin, gedunin, etc. These compounds are responsible for diverse activities such as insect antifeedant, insect growth disrupting, insecticidal, nematicidal, fungicidal, bactericidal, etc [11]. Azadirachtin, whose chemical structure is shown in Fig. 1, is the most potent and the most abundant chemical found in seed kernels of neem [12]. Methyl Eugenol is found in leaves, fruits, stems, and roots of *Eugenia caryophyllata* Thunb, isolated from Clove oil is an essential oil extracted from the plant [13]. It also found in *Ocimum sanctum*, lemon balm, ginger and cinnamon. Parietin is a predominant compound of the lichen *Xanthoria parietina* Linnaeus, is reported ant proliferative, antibacterial and antifungal activity [14]. Lantadene is isolated from *Lantana camara* leaves, shows antibacterial, anti-inflammatory, antitumor and anti AIDS activity [15]. Bio-pesticides are generally eco-friendly, low cost, market's appeal, target-specific, easily biodegradable and so on. The demands for more bio-pesticides from natural sources are continuously increasing day by day. Therefore, it is necessary for a regular study of these bio-pesticides from the plants for using in the agricultural fields.

2. Literature Review
Biopesticides are developed from naturally occurring living organisms such as animals, plants, and microorganisms that can control serious plant- damaging insect pests by their nontoxic eco- friendly mode of actions, therefore reaching

importance all over the world. Bio-pesticides and their by-products are mainly utilized for the management of pests injurious to plants [16]. Sengottayan Senthil-Nathan *et al* reported that the bio-pesticides are classified into three different categories: (i) plant-incorporated protectants, (ii) microbial pesticides, and (iii) biochemical pesticides. They do not have any residue problem, which is a matter of substantial concern for consumers, specifically for edible fruits and vegetables. When they are used as a constituent of insect pest management, the efficacy of bio-pesticides can be equal to that of conventional pesticides, particularly for crops like fruits, vegetables, nuts, and flowers [17]. Kumer *et al* reported by combining synthetic pesticide performance and environmental safety, bio-pesticides execute efficaciously with the tractability of minimum application limitations and with superior resistance management potential [18].Copping and Menn observed that biopesticides have been gaining attention and interest among those concerned with developing environmentally friendly and safe integrated crop management compatible approaches and tactics for pest management. Insecticides from microorganisms extend a unique chance to developing countries to research, and they have possessed to develop natural biopesticide resources in protecting crops. The utilization of bio-pesticide programs would be required to prevent the development of resistance in target insect pests to synthetic chemical pesticides and toxins from bio-pesticides [19]. Sengottayan Senthil-Nathan *et al* reported that the bio-pesticides are frequently target specific, are benign to beneficial insects, and do not cause air and water quality problems in the environment, and also agricultural crops can be reentered soon after treatment. Microorganisms from nature can also be used in organic production, and risks to human health are low [17]. Bio-pesticides derived from bacteria like *Bacillus thuringiensis* (Bt), a large array of fungi, viruses, protozoa, and some beneficial nematodes have been formulated for greenhouse, turf, field crop, orchard, and garden use [20, 21]. Organic farming is a method of crop and livestock production that involves much more than choosing not to use pesticides, fertilizers, genetically modified organisms, antibiotics and growth hormones [5]. Jadeja, G.C *et al* reported the extraction of natural insecticide azadirachtin from neem (Azadirachta indica A. Juss) seed kernels using pressurized hot solvent as a bio-pesticide [12]. Riyanto *et al* reported the synthesis of methyl eugenol from crude Cloves leaf oil using acid and based chemicals reactions [13]. Parietin is a predominant compound of the lichen *Xanthoria parietina* Linnaeus, is reported antiproliferative, antibacterial and antifungal activity [14]. Sharma S. *et al* found that Lantadene is isolated from *Lantana camara* leaves, shows antibacterial, anti-inflammatory, antitumor and anti AIDS activity [15].

3. Results & Discussion

3.1 Azadirachtin

Azadirachtin ($C_{35}H_{44}O_{16}$) is the most active principle present in Neem extract [22], whose chemical structure is shown in Fig. 1. It is a chemical compound belonging to the limonoid group, is a secondary metabolite present in neem seeds. It is a highly oxidized tetranortriterpenoid which boasts a plethora of oxygen-bearing functional groups, including an enol ether, acetal, hemiacetal, tetra-substituted epoxide and a variety of carboxylic esters. Azadirachtin has a complex molecular structure; it presents both secondary and tertiary hydroxyl groups and a tetrahydrofuran ether in its molecular structure, alongside 16 stereogenic centres, 7 of which are tetrasubstituted. These characteristics explain the great difficulty encountered when trying to prepare this compound from simple precursors, using methods of synthetic organic chemistry. Hence, the first total synthesis was published over 22 years after the compound's discovery: this first synthesis was completed by the research group of Steven Ley at the University of Cambridge in 2007 [23, 24]. Azadirachtin fulfills many of the criteria needed for a good insecticide. Azadirachtin is biodegradable which degrades within 100 hours when exposed to light and water and shows very low toxicity to mammals, the LD_{50} in rats is > 3,540 mg/kg making it practically non-toxic [25]. This compound is found in the seeds (0.2 to 0.8 percent by weight) of the neem tree, *Azadirachta indica*. Many more compounds, related to azadirachtin, are present in the seeds as well as in the leaves and the bark of the neem tree which also show strong biological activities among various pest insects [26, 27]. Some laboratory and field studies have found neem extracts to be compatible with biological control. Because pure neem oil contains other insecticidal and fungicidal compounds in addition to azadirachtin, it is generally mixed at a rate of 1 ounce per gallon of water when used as a pesticide.

3.2 Methyl Eugenol

Methyl eugenol (allylveratrol) is a natural chemical compound classified as a phenylpropene, a type of phenylpropanoid. It is the methyl ether of eugenol and is important to insect behavior and pollination [28]. It is found in various essential oils. Methyl eugenol is isolated from cloves leaf oil using acid and based chemicals reactions. Clove leaf oil has been use for propose of medicinal uses are related to its antiseptic and analgesic properties. It has been widely used as a method for preventing tooth decay and toothaches, as well as a cure for nausea, hernia, intestinal gas, diarrhea and fungal infections. Some viral infections respond well to clove oil's antiseptic and bactericidal properties. In tropical Asia, clove is used to combat malaria, cholera, tuberculosis and parasitic illnesses. As a topical ointment, cloves can also be used to alleviate muscle spasms, acne, skin ulcers and styes in the eyes. Clove oil is also a potent insecticide, repelling disease-causing mosquitoes and other insects. Clove oil is an essential oil extracted from clove plants (Eugenia caryophyllata thunb), especially from its flowers, stems and leaves. The quality of clove oil is normally indicated by its eugenol and carryophyllene contents [13].

3.3 Parietin

Parietin is the predominant cortical pigment of lichens in the genus *Caloplaca*, a secondary product of the lichen *Xanthoria parietina*, and a pigment found in the roots of Curled Dock (*Rumex crispus*). It has an orangy-yellow color and absorbs blue light. It is also known as physcion. It has also been shown to protect lichens against UV-B light, at high altitudes in Alpine regions [29]. The UV-B light stimulates production of parietin and the parietin protects the lichens from damage. Lichens in arctic regions such as Svarlbard

retain this capability though they do not encounter damaging levels of UV-B, a capability that could help protect the lichens in case of Ozone layer thinning [30, 31, 32]. It has also shown anti-fungal activity against barley powdery mildew and cucumber powdery mildew, more efficiently in the latter case than treatments with fenarimol and polyoxin B [33].

3.4 Lantadene

Lantadene is a pentacyclic triterpenoid present in the leaves of *Lantana camara* plant. It is to have antibacterial, anti-inflammatory, antitumor, anti AIDS and insecticidal activity [15]. Lantadenes, the pentacyclic triterpenoid fron *Lantana camara* plant cause inhibition of *Epstein Barr* virus activation.

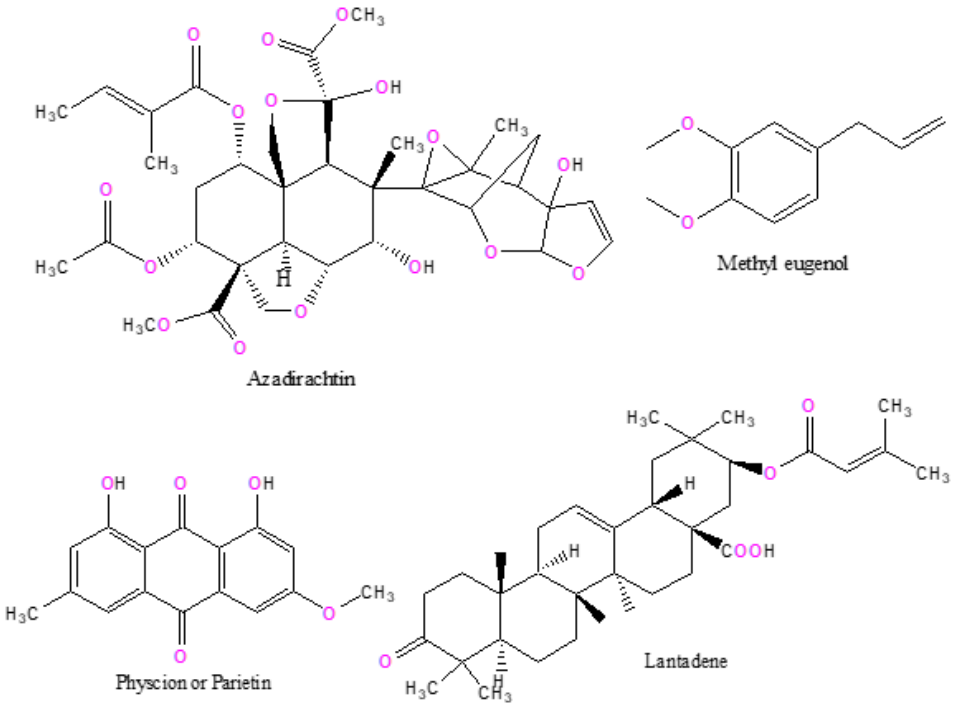

Fig 1: chemical structure of bio-presticide

4. Conclusions

Bio-pesticides are generally environment friendly, low cost, market's appeal, less pollutant, less residue and easily biodegradable. Organic farming is the best way for food safety. Therefore, the demands for bio-pesticides for organic farming are continuously increasing day by day. Thus the investigation of the bio-pesticide might generate organic farming method in the field of agricultural study.

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