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Organic- Pesticides

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Abstract **Review Article**

Over the years, extensive use of commercially available synthetic pesticides against phytophagous insects has led to their bioaccumulation in the environment causing increased resistance and reduction in soil biodiversity. Further, 97% of the applied pesticides enter the various environmental resources as a result of run-off, exposing the farmers as well as consumers of the agricultural produce to severe health issues. Therefore, growing attention has been given toward the development of alternate environmentally friendly pesticides/insecticides that would aid an efficient pest management system and also prevent chronic exposures leading to diseases. One such strategy is, the use of Garlic (Allium Sativum), Green Chili Pepper (Capsicum frutescens), Clove(*Syzygium aromaticum*), Ginger(Zingiber officinale) active ingredients which exhibit agro-medicinal properties conferring insecticidal as well as Antibacterial [1], Antifungal [2], E. coli and Pseudomonas solanacearum [3], antimicrobial, Antioxidant, harmful microorganisms properties.which has been established as a pivotal insecticidal ingredient. It acts as an antifeedant, repellent, and repugnant agent and induces sterility in insects. This review discusses, key Garlic, Green Chili Pepper, Clove, Ginger pesticidal components, their active functional ingredients along with recent strategies, to provide controlled release of the active ingredients and to improve their stability and sustainability.

Keywords: Pesticides, biopesticide, Allium Sativum, Capsicum frutescens, *Syzygium aromaticum*, Zingiber officinale agro-medicinal components, sustained delivery.

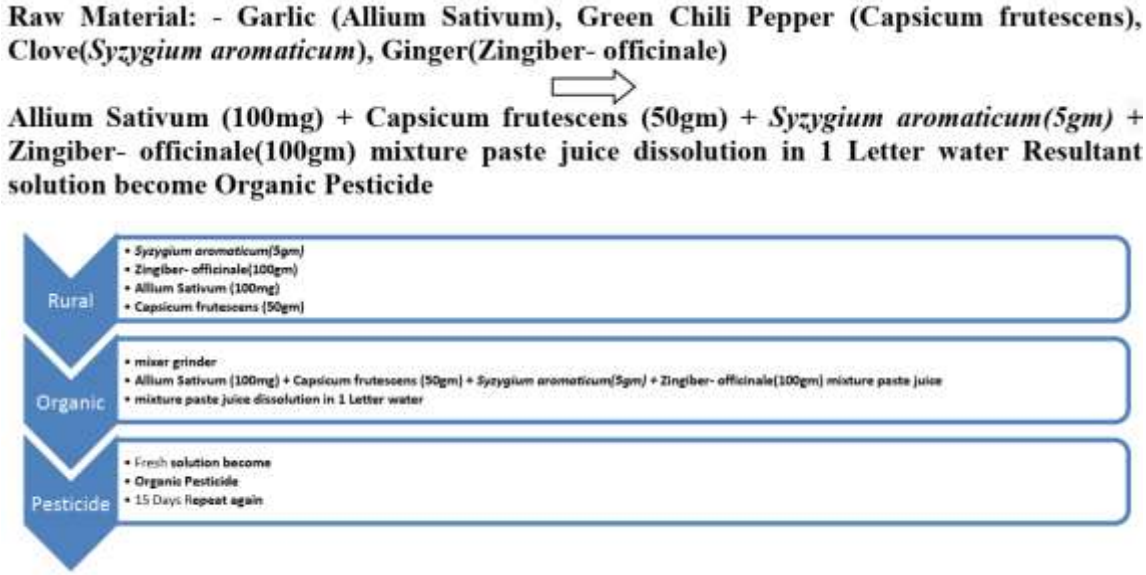
INTRODUCTION

Pesticides are chemical substances used in agricultural practices to aid the production and yield by repelling, preventing, and destroying pests. However, over the years, continuous application of synthetic pesticides in agriculture has caused accumulation of pesticidal residues in the environment. Pesticides are responsible for poisoning around 300,000 people die from self-harm each year in the Asia-Pacific region alone. Such cases are reported more in developing Asia-Pacific region countries. On the basis of the types of pest controlled, pesticides are divided into subcategories including insecticides, fungicides, herbicides, Rodenticides, Pediculicides, and biocides. Most of these pesticides are stable compounds with long half-lives ranging from a few weeks to years due to their persistence in soil and water sources and they also enter the food chain leading to increased health risks. Pesticide exposure can occur via various means, such as inhalation of aerosols or droplets of pesticides, which can be absorbed physiologically through the respiratory system. Dermal contact can also lead to exposure and poisoning, through the consumption of directly contaminated food or through food coming in contact with contaminated hands that can lead to pesticide poisoning. Most of the highly toxic pesticides are readily metabolized and eliminated by the body, however, acute short term exposure can lead to their accumulation. The active ingredients, carriers, solvents, and emulsifiers present in pesticides can cause severe side-effect. The severity of the effects of exposure is dependent on various factors such as the intake dose, route of exposure, pesticide absorption in the body, their accumulation efficacny and persistence. In most cases, metabolism of pesticides in the body makes them water-soluble, so that the body can readily excrete them. However, sometimes metabolism can increase the toxicity, Furthermore; some fat-soluble substances are not metabolized by the body and get stored in the fatty tissues leading to their accumulation. They become even more concentrated while passing through the food chain. Such cases cause various toxic effects including, skin sensitization, allergic reaction rashes, neurotoxicity, carcinogenic, reproductive, and endocrine defects, cataract formation and defects in the immune system. Synthetic pesticides to various types of diseases with exposure to various insecticides, herbicides and fungicides. Synthetic pesticides has led

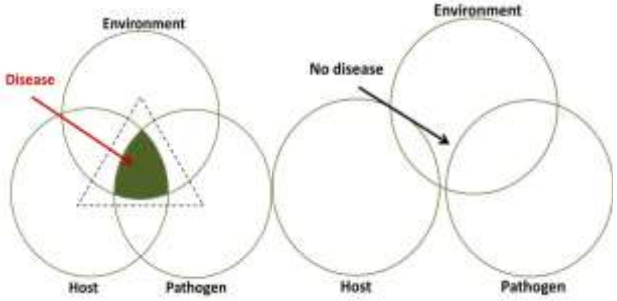
to disturbances in the environment, causing pest resistance and toxicity to non-target organisms have caused acute and chronic poisoning to farm workers, Organic pesticides to replace the wide use of synthetic pesticides. Organic based bio-pesticides using organic extracts and residue have proved to be the most efficient way of insect control. These organic pesticides aid the agricultural yield, as they can be used as insecticides, fumigants, manures.

Table-1: Common herbs with active ingredients containing insecticidal properties

Organic Raw Material	Active Ingredient
Garlic(Allium Sativum)	3-vinyl-1,2-dithiacyclohex-5-ene and 3-vinyl-1,2-dithiacyclohex-4-ene, ulfur compounds like diallyl thiosulfinate (allicin), diallyl trisulfide, allyl methyl trisulfide, diallyl disulphide, ajoene
Green Chili Pepper (Capsicum frutescens)	**Ethylene, ABA,** 8-methyl-*N*-vanillyl-6-nonenamide,vItamin B-6,Provitamin A Beta Carotene, vitamin-C
Clove(***Syzygium aromaticum***)	Eugenol(50–87%),Eugenyl acetate, Tanene, Thymol**,** β-cariophyllene
Ginger(Zingiber- officinale)	Polyphenols, Quercetin, Zingerone, Gingerenone-A, and 6-dehydrogingerdione



Covered: *Agrotis ipsilon* (Black cutworm), *Bemisia tabaci* (Silverleaf whitefly), *Cacopsylla chinensis, Callosobruchus maculatus* (Cowpea weevil), *Delium radicum* (Cabbage root fly), *Heteracris littoralis* (Grasshopper), *Lycoriella ingénue* (Sciarid fly), *Pezothrips kellyanus* (Kelly's citrus thrips), *Sitophilus oryzae* (rice weevil), *Sitophilus zeamais* (Maize weevil), *Tribolium castaneum* (Red flour beetle), *Trichoplusia ni* (Cabbage looper), Nematicide, *Melodigyne incognita, Globodera pallid, Bursaphelenchus xylophilus, Bursaphelenchus xylophilus,* Molluscicide, *Deroceras panormitanum*(Slug), *Oxyloma pfeifferi*(Snail), *Aspergillus flavus, Aspergillus niger, Botrytis cinerea, Fusarium oxysporum, Penicillium expansum, Pythium aphanidermatum, Rhizoctonia solani,* Leaf anthracnose (Colletotrichum spp), Fruit rot, Contagious disease,



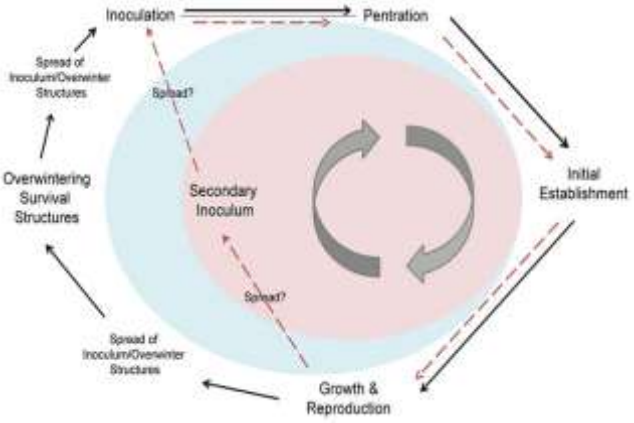


Table-2: List of commercially available synthetic pesticides, with their toxicity

Name	Side effects	Type of toxicity
Aldicarb (Insecticide)	Acutely toxic Pesticide causes excessive, sweating. Salivation, vomiting, diarrhea, muscle twitching and difficulty in breathing.	Suppression of immune system, mutagenic, carcinogenic, effects on reproduction and development.
Chlorpyrifos((Insecticide)	Cholinesterase inhibition, salivation, dyspnoea, vomiting, diarrhea and exothalmia.	Nervous system damage, endocrine disruption
Parathion(Insecticide)	Headache, nausea, adverse effects on reproductive system	Severe poisoning can cause psychosis, unconsciousness, convulsions, cardiac arrest and coma
Monocrotophos	Headache, nausea, weakness, hypersalivation, blurred visions	Hazardous, accidental or intentional exposure can lead to death. Poisoning affects the central nervous system and causes loss of reflexes, involuntary muscle contractions and paralysis
Carbofuran(Insecticide)	Headache, nausea sweating, chest pains, anxiety, blurred vision due to the rapid inhibition of cholinesterase activity by carbofuran	Poisoning can lead to various neurological, psychological and cognitive effects such as anxiety, depression, short-term memory loss, blurred vision
Endosulfan(Insecticide)	Difficulty in breathing, in coordination, vomiting, diarrhea,	Chronic toxicity can lead to seizures, changes in kidney structure, blood chemistry
Atrazine(Herbicide)	Abdominal pain, vomiting, diarrhea, eye irritation, slowed breathing, muscle spasms, breathing difficulty	Animals with an oral dose: paralysis of limbs, respiratory distress, structural and chemical changes in lungs, liver kidney, ovaries and growth retardation
Paraquat(Herbicide)	Acute respiratory distress, thirst, nausea, headache, fever, muscle pain, nail damage, temporary nail loss	Leads to the production of free radicals and oxidative stress, causing cell death Accelerates the development of Parkinson's disease. Paraquat can cross the placenta causing acute toxicity and death of the fetus
Glyphosate(Herbicide)	Anorexia, vomiting, hypersalivation and diarrhea, dysphagia gastrointestinal hemorrhage	Decreases body weight, increases incidence of cataract, lens degeneration, mutagenicity and reduces sperm count
Carbendazim(Fungicide)	Acute toxicity is low, but direct contact can lead to discomfort in eye, skin irritant, irritation of respiratory tract, chronic bronchitis	Minor effects on cellular respiratory function, interference with the mitotic spindle proteins, no teratogenicity concern for dietary exposure
Mancozeb(Fungicide)	Cholinesterase inhibitor Causes, headache, nausea, blurred vision, skin rash	Impairs thyroid function, and is mutagenic

However, neither of the formulations caused any significant effect on the fecundity of the insects and the mortality rate was not immediate. Its stop by compared the efficacy of three synthetic pesticides, endosulfan, cypermethrin, and imidacloprid, along with environmentally friendly. Although among the three insecticides tested, imidacloprid exhibited the highest efficiency against the pest. Bio-pesticides based on a organic pesticides solution formulation also presented significant efficacy. Therefore, the sole dependency synthetic pesticides can be easily modified by inculcating an eco-friendly management program the seed cake produces high-quality natural manure also increases the soil fertility. Powdered seed granules are used as soil conditioners to improve the quality of soil enhances plant growth [4].

FUTURE PERSPECTIVE

Recently emerging issues regarding the increasing prevalence of pest resistance has prompted the adoption of alternative strategies with special emphasis on integrated pest managements. Bio-pesticides is an ideal alternative candidate as a natural non-synthetic plant pesticide .Over the years, numerous research has validated its pesticidal activity. It is a cost effective and eco-friendly alternative to the commercial chemically synthesized pesticides. However, owing to its instability to ultraviolet light and limitation of less efficiency as compared to its synthetic counterparts [5], it is vital to develop a novel and efficient strategy to replace toxic chemically synthesized pesticides. This can be achieved by utilizing the past knowledge of phytocomponents with pesticidal activity and

integrating it with current innovative strategies to develop a unique and effective pest management tool. Dual benefit of controlled delivery of the functional ingredients as well as biodegradable and non-toxic carriers can act as a turning point of modern agriculture. Due to their small size and ease in surface modifications [6] can also support the upcoming sustainable agricultural practices. Can not only act as anti-feedant, ovicidal, sterilant, and morphological and physiological defects in insects but also as a herbal fertilizer. The property of slow release of active ingredients in the soil, conditions the soil and provides nutrients that promote the growth of plants [7], which can revolutionize the industry of botanical fertilizers. Which can revolutionize the industry of botanical fertilizers. However, integration of a targeted approach to prevent the side-effects on non-target and ecologically important organisms is an important aspect which still needs to be addressed. Additionally, this meliaceae plant has unique agro-medicinal properties. Since, parallel to its efficacy as a bio-pesticide it also instills immunomodulatory [8], anti-microbial [9], and wound healing [10] properties, which can pave way to an interdisciplinary approach by integrating the attributes of this plant to provide multiple benefits in agriculture.

CONCLUSIONS

The environmental risks associated with the continuous use of synthetic pesticides have prompted the use of plant based insecticidal components that provide selective toxicity to insects with minimum off target effects. The use of botanical pesticides offers eco-friendly pest control strategy to aid the agricultural practices. Among the various herbs, plant based insecticides has been the most accepted bio-pesticides, Garlic (Allium Sativum), Green Chili Pepper (Capsicum frutescens), Clove (*Syzygium aromaticum*), Ginger(Zingiber officinale) that not only provides a sustainable pest control mechanism but also prevents plant disease resistance, from various synthetic insecticides. That facilitates in providing sustained and control release of phytochemicals along with site targeted delivery thus, increasing the productivity and yield of crops.

AUTHOR CONTRIBUTIONS

The primary manuscript was written by SR and DP. Substantial comments and editing was provided by SR and DP to provide an improved draft. All authors have read and approved the manuscript for publication.

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