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Neem-Based Nanoformulations for Improved Management of Pests in Tea (*Camellia sinensis* L.): Current Advances

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ABSTRACT

Tea (*Camellia sinensis* L.) is attacked by a wide range of insect pests that significantly reduce yield and quality, leading to heavy reliance on chemical insecticides for their control. Prolonged and indiscriminate use of these chemicals in tea plantations has resulted in the development of pest resistance, pesticide residues in tea products, and adverse ecological impacts. The formulations made of neem are a green alternative to the traditional pesticides. Nanotechnology has made it possible to develop the neem-based formulations to increase bioavailability of such phytochemicals. These nano-enabled products have an enhanced deadly and sub-lethal effect when it comes to the key tea pests. This article summarizes the present developments, performance, and future of neem-based nano-formulations in sustainable tea pest management. This article reviews the current progress, effectiveness, and future prospects of neem-based nano-formulations as a sustainable approach to tea pest management.

Keywords: Tea pests, neem-based formulations, ecofriendly pest management

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Introduction

Tea trees 60 or 70 million years ago discovered in southwest China and in written source Chinese start drinking tea 3000 years ago. Additionally drinking tea can help people experience longevity as well as joyful satisfaction, relaxed, calm and rejuvenated and although there are 3 billion users of tea globally. its various health advantages anticancer, anti-diabetic anti-inflammatory, cardiovascular-preserving, antioxidant, noninflammatory and anti-obesity [1]. Over the past few centuries like China, Kenya, India, and Sri Lanka have increased both production and consumption of tea. annual growth in tea production Between 1991 and 2000 was 2.31%, from 1078.17 million kg to 1324.65 million kilograms and From 2001 to 2012 was average annual growth rate of 3.4% exports increased from 1400.55 million kg to 1740 million kg in worldwide [2].Commercial tea is classified into three primary categories and drank worldwide fully fermented black tea 78%,non-fermented green tea 20% and semi-fermented oolong tea 2%.Fresh tea leaf consists of amino acid 4%,carbohydrate by 25%,organic acid by 51.5%,protein by 15%,poly-phenol by 36%, lignin by 6.5%,chlorophyll by 0.5%,ash by 5%,and carotene and volatile chemicals by less than 0.1% in dry matter [3].Worldwide,1031 arthropod species and one species feed each part of the plant including seeds, stems, flowers, leaves, roots and if unchecked yield loss 11% to 55% [4].Globally, Tea plants are linked to 1034 species of arthropods and 82 species of nematodes (Chen and Chen (1989)and in Bangladesh 4 mite species,25 insect species and 10 nematode species are recorded (Ahmed, 2005). Tea pest can be divided into three groups leaf pest, such as looper caterpillar, tea mosquito bugs, flush worm, leaf roller, aphid, thrips and all mite stem pest, such as red coffee borer and root pests, such as cockchafer grub, termites and nematodes (Mamun and Iyengar, 2010) [5].

Neem Phytochemicals and Their Insecticidal Importance: These days "neem" provide "good health" refers to the Neem (*A.indica*) tree. The neem tree is mostly grown in southern Africa and Asia. The various parts of the neem trees including the bark, flowers, leaves, gum and oil are treatment in the number of illnesses, including hypertension, heart disease, Diabetes and cancer to the previously described medicinal folklore [6]. Two most significant groups of phytochemicals Isoprenoids and non-isoprenoids and more than 300 phytochemicals. isoprenoids include triterpenoids, limonoids and isoprenoids and the non-isoprene sulfur include compounds, Proteins, tannin, sugars (polysaccharides), polyphenolics such as flavonoids and their dihydrochalcone, glycosides, coumarin, phenolic acids and aliphatic chemicals [7]. Phytochemicals have a significant impact on reject the plant or whether pests accept on one hand, chemicals may be offensive or harmful but alternatively, organic items give benefits them [8].

Types of Neem-Based Nano-Formulations:

Neem oil nano emulsions are more efficient, reliable, and provide superior functions. Neem oil nano emulsion gaining research in a various field including agriculture and food sector and use starch, chitosan, or pectin-based active packaging of foods including vegetables and fruits [9]. Nanotechnology gives the various benefits to the food industry and excepts to prove the solution to the industry's problems. Advantages and opportunities; such as, intelligent prepackaging, promising processionals, the creation of environmentally friendly techniques, beverage products, low-calorie food and the creation of products with desirable textures and tastes [10]. Conventional pesticides can be effectively tackled by creating an ecologically friendly pesticide delivery system (PDS) based on multiple financiers and nanotechnology provide fresh pesticide formulation research and effectively solved nanosized, effective, safe pesticide system and targeted [11].

Toxicological Effects of Neem Nano-Formulations on Major Tea Pests: Major insect pest of tea including, the red spider mite, aphids, tea mosquito bug, bunch caterpillar, thrips, shot hole borer, tea looper complex, scavenger termites and live wood-eating termites [12]. Neem tree plant parts, including seeds, fruit, bark, flowers and leaves has been found having an insecticidal impact on insects. These biochemicals stop eating and oviposition, regulate insect growth and can block the production of cuticle in insects and are limited by their low stability and ease of degradation. The use of nanoparticles in the production of bioinsecticides will result in a product that is effective, safe, responsive and Recyclable. Neem biochemicals are able to produce nanocomposite, nano delivered, nano emulsified and nano emulsified nano bioinsecticides are easy to apply and equally effective [13].

Tea Pest Management:

Plant protection practices Cultural Practices is the most effective, environmentally friendly and risk free include Plucking, Pruning, Shade Regulation, Filed Sanitation, Fertilizer Application, Trap Crop. Physical Methods the goal of this approach is to lower the number of pests by employing tools like Hand Destruction, Heat Treatment and Soil Isolation, Light Traps. Biological Control Predator, Parasitoids, Pathogen, Botanical Products and Use of Sex Pheromone. Chemical control, pesticide play a vital role to pest control like DDT was extensively used [14]. Neem plants are the most important source of botanical pesticide. About Neem has been used to control pests in many kinds of formulations, including neem decoction, neem cake, neem seed kernel extracts (NSKE), and neem oil. Thus, red spider mites, Looper caterpillars, thrips, and nematodes can all controlled by neem [15]. Adopted, many agriculture management techniques (AMPs)for ecological advancement, including contour farming, crop rotation, planting of shade trees, agroforestry cropping systems, Cover crops a productive agricultural method for ecological intensification [16].

Conclusion: In terms of dealing with the pests of tea, neem nano-formulations are an option to overcome the disadvantages of traditional botanical insecticides. The nanoencapsulation and controlled-release systems enhance phytochemicals in neem in terms of their effectiveness, persistence, and penetration. These formulations report better toxicological impact against tea pests compared to traditional formulations. They are often equally effective as synthetic pesticides, and they are also less harmful to non-target organisms and the environment. Mass field tests and detailed safety tests are however quite limited. Further research to help in the production of sustainable tea should focus on the field testing, legal structure, and its integration with IPM systems.

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