International Journal of Pharmaceutical research and Applications
Volume 8, Issue 4, Jul.-Aug. 2023, pp: 1655-1662 www.ijprajournal.com ISSN: 2456-4494

Eco-Friendly Biosynthesis And Characterization Of Zno Nanoparticles Using *Euphorbia Cyathophora* Leaf Extract Against Larva Of Agricultural Pest Earias Vitella

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Date of Submission: 01-08-2023 Date of Acceptance: 13-08-2023

Abstract

In the current study, we suggested employing an extract from Euphorbia cythophor leaves to create ZnO nanoparticles in a sustainable manner. A wide variety of uses, particularly as antibacterial agents, are available for ZnO nanoparticles. There are several ways to make ZnO nanoparticles, but one excellent alternative and environmentally beneficial option is to make ZnO nanoparticles using plant matter. As a biological reducing agent for the manufacture of ZnOnano particles from zinc nitrate, leaves extract was employed. The produced nanoparticles were evaluated using a variety of analytical and spectroscopic methods, including scanning electron microscopy (SEM) analysis, X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FT-IR), and UV visible spectroscopy. Agriculture insect pests have the potential to directly or indirectly harm farm animals, people, and stored goods. Earias vittella is an extremely dangerous polyphagous agricultural insect pest that is found all over the world. In addition to high operational expenses, frequent insect outbreaks, the creation of new pests, pollution, and health risks for both humans and wildlife, the use of synthetic chemicals in pest management has led to physiological resistance and harmful environmental repercussions. Using Euphorbia cyathophora as a reducing and stabilizing agent, we investigated the Earias vittella efficacy of green synthesized zinc oxide nanoparticles (ZnO NPs), an alternative to plant-based pest management systems that is environmentally acceptable. Overall, the current E. cyathophora nanoparticle is a quick-acting, appropriate, biodegradable, and environmentally acceptable method for the control of E. vittella.

Keywords: Green nanoparticles, Euphorbia cyathophora, ZnONPs,Biophysical characterization, larvicidal activity of Earias vittella

I. Introduction

Numerous researchers have been interested in ZnO NPs recently because to its distinctive optical and chemical properties, which can be easily controlled by modifying the morphology. ZnO NPs, a member of the large family of metal oxide nanoparticles, are employed in a variety of cutting-edge applications, including those in the fields of electronics, communication, sensors, cosmetics, environmental. Additionally, ZnO NP has enormous potential for use in biological applications such as nanomedicine, biological sensing, biological labeling, gene transport, and pharmaceutical delivery. along with its acaricidal, pediculocidal, larvicidal, anti-diabetic, antibacterial, and anti-fungal properties.Due to its low cost, ability to be produced in ambient air, lack of toxicity, environmental compatibility, etc., and ease of use due to the fact that the resulting particles are highly soluble in water, biocompatible, and free of toxic

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stabilizers, environmentally friendly methods of producing NPs have recently gained popularity among researchers. Plant extracts have great promise for the quick and environmentally friendly production of NPs. Various researchers have utilized Citrus aurantifolia fruit juice, Parthenium hysterophorus leaf extracts, and Aloe sp. extracts in the manufacture of ZnO NP Physalis alkekengi has also been observed to produce ZnO NP in vivo. Medicinal plants are an important element of herbal wealth, and these plants, which contain beneficial phytochemicals, may also supplement the needs of the human body by acting as herbal antioxidants. However, the plant has been utilized to treat human illnesses for hundreds of years since it has a large and diverse collection of natural substances that can cause a particular physiological motion at the human frame (Nayak& Krishna, 2007; Bootset al., 2008). Many of these benefits suggest that phytochemicals may play a role in illness prevention and treatment . Euphorbia cyathophora, also known as dwarf poinsettia, fire-on-the-mountain. and paintedleaf, is native to North and South America and has become naturalized elsewhere. E. cyathophora is a herbaceous to shrubby annual plant that grows up to 1.50 m tall, is glabrous or loosely hairy, and has multicellular hairs. The stem is hollow, cylindrical with ribbed older, hollow, glabrous or sparingly pubescent, yellow with a white latex. It bears leaves along its entire length or, in elder plants, only at the apex. The leaves are simple and stalked, with lower leaves alternating and higher leaves opposite. The blade form varies. The terminal leaves are completely red or white. Flowers are little and greenish-yellow, housed in small cups with a small gland flattened bi-lobed on the edge. To three-quarters of the way out of the cup, the fruit is globose. They are a form of Cyathium inflorescence. The inflorescence axis is convex in this case. Earias vittella, often known as the "spotted bollworm" of Asia, is a species of moth in the Nolidae family. Johan Christian Fabricius described the species for the first time in 1794. The majority of records come from Asia, Australia, and a few Pacific islands. The shoot and fruit borer, Earias vittella Fab. (Lepidoptera: Nolidae), is a significant and destructive insect pest of okra and cotton. The pest is primarily responsible for causing severe direct damage to okra vulnerable shoots and fruits, as well as cotton blooms and green bolls, resulting in net output loss in both crops. The insect pest management program has resulted in the development of numerous non-chemical control techniques. Future electrophysiological and behavioral studies will require a thorough understanding of E. vitella's antennal morphology. The antennal morphology and sensilla types on the antennae of both sexes of E. vitella were studied using light and scanning electron microscopy in this work. On the antennae of both sexes, nine different sensilla species were identified: sensilla trichodea, sensilla trichodea, sensilla trichodea, sensilla trichodeUV-visible (UV-VIS) spectroscopy was used to evaluate the optical characteristics of the produced NPs.

II. MATERIALS AND METHODOLOGY

Collection and Identification of Plant Material

Fresh leaves of *Euphorbia cyathophora*were collected from in and around of Namakkal district, Tamilnadu, India. The plant was taxonomically identified and authenticated by the PG and Research Department of Botany,KandaswamiKandar's College, Velur-NamakkalTamilnadu. The voucher specimen was retained in our laboratory for further reference.

Fig 1 – Euphorbia cyathophora

Preparation of plant extract

The leaves were cleaned with tap water and shade-dried at room temperature (282°C) for 5 to 10 days. Because certain components denature in sunshine, it is dried in the shade to avoid decomposition. 250 g of fresh, mature leaves were rinsed with distilled water and dried in the shade. The dried leaves were placed in a Soxhlet apparatus (Borosil Glass Workers Ltd, Mumbai, India) and chloroform, acetone, and methanol extracts were made [(LobaChemiePvt. Ltd., Mumbai, India. 99% purity) (concentration of chloroform, acetone, and methanol is 100%, extraction duration is 72 hours, and temperature is kept between 30 and 40°C)]. The yield extract was 100g and was evaporated to dryness in a rotary vacuum evaporator before being

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stored in sealed bottles in a refrigerator for future use.

Preliminary Phytochemical screening:
Preliminary phytochemical testing of E.cyathophora leaf extracts was carried out using Harborne's (1973) and Trease and Evans' (1989) conventional qualitative procedures. The presence or absence of various phytochemical groups has been determined using phytochemicals.

Characterization methods
(i) UV-Vis spectra analysis: Using UV-Vis spectrophotometry, the sample's maximum absorbance was determined. Utilizing a spectrophotometer (Cary E 500) and ultraviolet and visible absorption spectroscopy, the optical properties of ZnO nanoparticles between 200 and 800 nm were examined.
ii) FT-IR, or Fourier transform infrared spectroscopy: By using FTIR analysis, the binding capabilities of ZnO nanoparticles were studied. The dried powder of the produced ZnO nanoparticles was subjected to Fourier transform infrared spectroscopy (FTIR) analysis utilizing a Perkin Elmer Spectrum 1000 spectrum in attenuated total reflection mode, with a spectral range of 4000-400 cm1 and a resolution of 4 cm1.
(iii) SEM, or scanning electron microscopy ; Scanning electron microscopy (SU3500, Hitachi with spectral imaging system Thermo Scientific NSS (EDS), the tape of detector (BSE-3D), acceleration voltage (15.0 kV), working distance (11.6 mm), and pressure (in the case of variable vacuum conditions) (40 Pa) were used to examine the morphology of ZnO nanopartic
(iv) X-ray diffraction (XRD): Using Ultima IV (Rigaku, Japan) at a wavelength of 1.5406 A °, an appropriately cleansed and dried sample of produced ZnO nanoparticles was employed for the XRD investigation. With a divergence slit of 10 mm and a divergence slit of 40 kV and 40 mA in continuous scanning mode, XRD was conducted in the 2 h range of 20-80°.

III. RESULTS

Numerous bioactive chemical components, including alkaloids, flavonoids, sterols, terpenoids, anthraquinones, polysaccharides, and essential oils, were found in various E. cyathophora leaf extracts after a preliminary phytochemical screening. All of the studied extracts lack the following anthocyanin phytonutrients: proteins, phenols, quinones, tannins, saponins, phytates, cardiac glycosides, glycosides, lignin, and coumarin. In all leaf extracts, alkaloids, flavonoids, and carbohydrates could be found. Except for acetone, sterols were found in the leaf extracts of chloroform and methanol. Only acetone extract contains terpenoids and anthracene.Additionally, acetone and chloroform extracts contained essential oils, whereas methanol extracts did not. Recently, eco-friendly control tools have been implemented to enhance agriculture pest control. Significant efforts have been carried out investigating the efficacy of botanical products, and many plant-borne compounds have been reported as excellent toxins for pest management, acting as adulticidal, larvicidal, ovicidal, oviposition deterrent, growth and/or reproduction inhibitors and/or adult repellents (Benelli *et al.*, 2015a, Murugan et al., 2015; Conti *et al*., 2014). Zinc oxide nanoparticles shows potent antibacterial activity towards both grampositiveand gram-negative bacteria. Zinc oxide nanoparticles inhibits food borne andmost dangerous pathogens as an antibacterial agent (De Souza et al., 2019).The mortality effect of the seaweed extract on *H. armigera* larvae may be due the active plant compounds that enter into the body of the larvae hindering normal physiological and metabolic processes, in particular suppressing the activity of ecdysone, then the larva fails to molt (Murugan et al., 2015) In particular, green-synthesized Zinc oxide nanoparticles are emerging as multipurpose materials, effective against different mosquito vectors (Rawanietal.2013a; Murugan et al 2015a, Subramaniam *et al*. 2015). Our present study compared with several previous studies confirmed that functional groups are present in different plants. In accordance with the earlier study, different functional groups such as aliphatic, alkynes, alcohols, amides, aromatics, carboxylic acids, hydroxy group, ketones, metal carbonyl, nitrile, and phenols are present in leaves, flowers, and barks

In the present study, UV visible spectrum of green synthesized zinc oxide nanoparticles analysis in the leaves extract of *E. cyathophora* are represented in **Fig.2.**

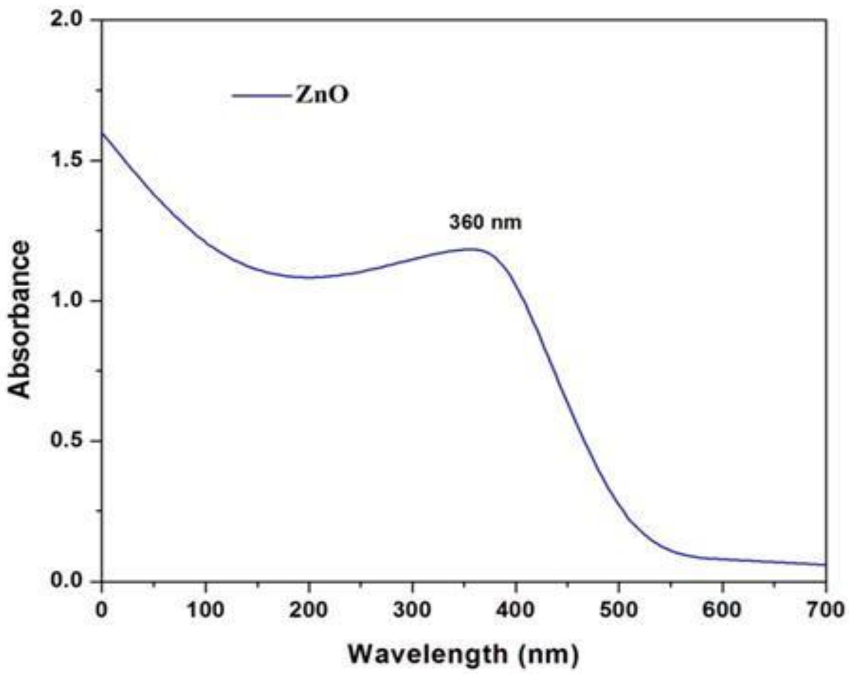

Fig :2. UV–Visible spectra of green synthesized zinc oxide nanoparticles

In the present study SEM micrograph showing the morphological characteristics of *Euphorbia cyathophora* synthesized zinc oxide nanoparticles leaves are represented in **Fig.3.**

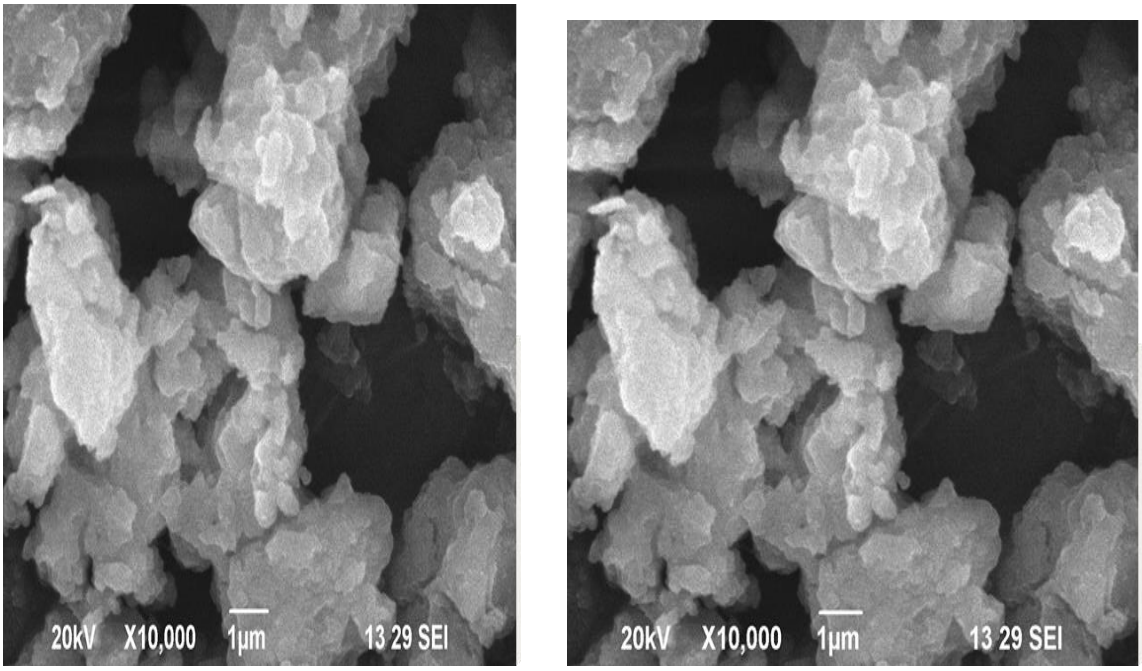

Fig: 3. SEM micrograph showing the morphological characteristics of *Euphorbia cyathophora* synthesized zinc oxide nanoparticles

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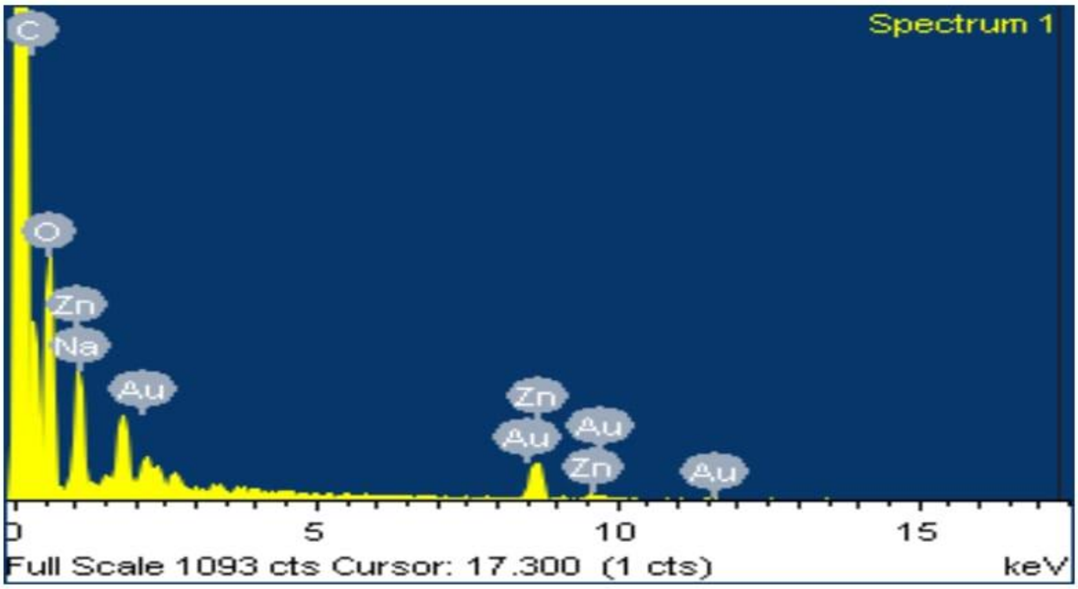

Fig: 4. EDX spectrum green synthesized zinc oxide nanoparticles using leaf extract *Euphorbia cyathophora*

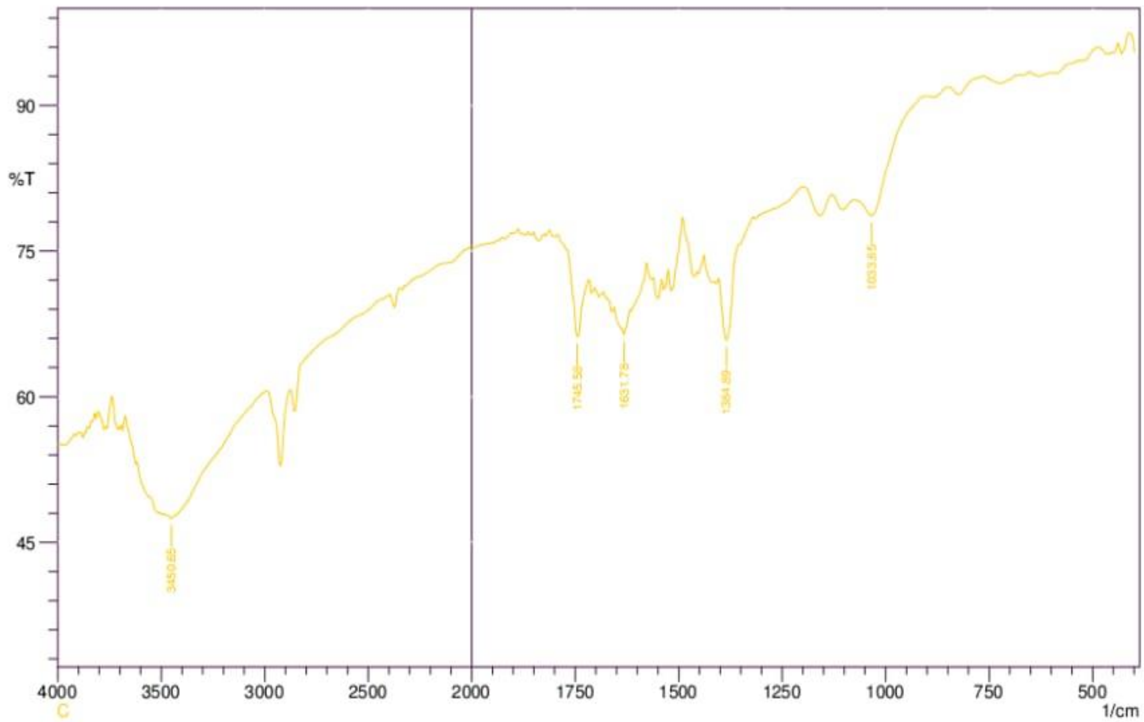

Fig: 5. FTIR green synthesized zinc oxide nanoparticles using leaf extract *Euphorbia cyathophor*

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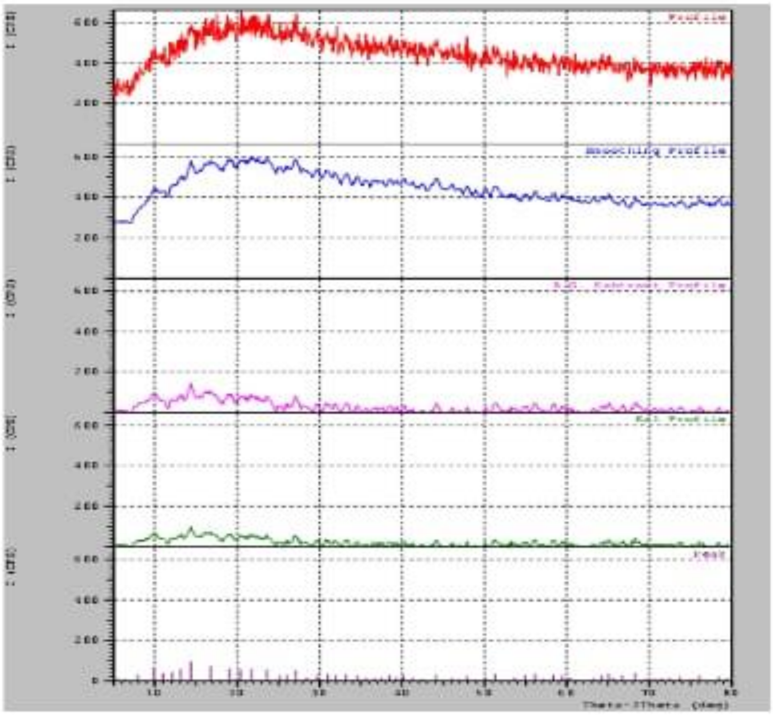

Fig: 6. XRD green synthesized zinc oxide nanoparticles using leaf extract *Euphorbia cyathophora*

In the present study larvicidal activity of green synthesized znonps using leaf extract of e.cyathophora against e.vittella **Table 1**

Table 1: larvicidal activity of green synthesized znonps using leaf extract of e.cyathophora against e.vittella

Life stages	% of larval mortality (mean± SD)					Regression Equation	LC_{50} (LC_{90}) (ppm)	95% Confidence limit		x^2
	Concentration (ppm)							LC_{50} (*LFL–UFL*) (ppm)	LC_{90} (*LFL –UFL*) (ppm)	
	50	100	150	200	250					
1^{st} Instar	47.5^{e}±1.70	60.5^{d}±1.29	83.5^{c}±2.08	91.2^{b}±1.70	93.2^{ab}±1.70	*Y*= -.50310 +0.00438*X*	12.478 (23.363)	(4.345-18.68)	(16.339-47.564)	3.32^{*}
2^{nd} Instar	41.0^{e}±1.82	49.7^{d}±1.70	71.0^{c}±2.16	84.7^{b}±2.50	90.5^{ab}±1.29	*Y*= -.70946 +0.00413*X*	13.946 (26.778)	(6.641-19.01)	17.501 (44.782)	1.66^{*}
3^{rd} Instar	37.5^{e}±1.29	41.2^{de}±2.21	66.5^{c}±2.08	81.2^{ab}±2.21	86.0^{ab}±1.82	*Y*= -.81741 +0.00393*X*	14.048 (28.148)	(8.7821-21.80)	(18.304 42.246)	4.04^{*}
4^{th} Instar	32.5^{e}±2.08	39.5^{d}±2.08	61.0^{c}±2.64	79.5^{b}±1.82	81.5^{a}±2.21	*Y*= -.76253 +0.00357*X*	15.722 (30.347)	(9.811-23.89)	21.781 (37.422)	2.26^{*}
5^{th} Instar	26.7^{e}±2.16	32.5_{de}±1.29	52.7^{d}±2.21	73.5^{bc}±2.38	78.5^{ab}±2.64	*Y*= -.09999 +0.00394*X*	17.103 (32.562)	(12.239-24.89)	(22.475 (38.577)	3.16^{*}

IV. CONCLUSION

Overall, this present research suggests that green synthesized Zinc oxide nanoparticles to evaluated the low dosages could be strongly reduce the *E. vittella* larval populationsIn the present study would be useful in promoting research development of nanobiopesticides agent for Agriculture crops management and *A. esculentus pest larvae of E. vittella* control based on plant source. The *E. cyathophora* synthesized Zinc oxide

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nanoparticles are good alternatives for the control of *E. vittella* with an ecofriendly strategy. Also a rapid progression, suitability, and biodegradable method.

Acknowledgments
The authors would like to acknowledge the PG and Research Department of Zoology, Kandaswami Kandar's College, Namakkal for providing the required facilities to perform the research work.

Conflict of interest
The authors declare no conflict of interest

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