BEMS Reports. 2020; 6(2): 19-21.
A Multifaceted Peer Reviewed Journal in the field of Biology, Medicine, Engineering and Science
www.bemsreports.org | www.phcog.net

Research Article

Efficacy of Natural Extract from Ocimum Species against Fungus Gnats Infesting Plant Saplings

Anya Kumar[1], Arun HS Kumar[2,*]

ABSTRACT

Background: Fungus gnats around household plants besides being annoying can also compromise the growth the plant saplings. Hence effectively repelling them without compromising their ecological purpose is necessary. **Materials and Methods:** We tested here the effectiveness of an aromatic natural extract of the Ocimum species in repelling the Fungus gnats naturally infesting *Catharanthus roseus* plant saplings. Ocimum extract was sprayed on the plant saplings and monitored for the presence of the Fungus gnats. The binding potential of selected compounds in the Ocimum extract was evaluated against known insect specific olfactory receptors to understand the mechanism of action. **Results:** Ocimum extract effectively repelled and reduced the fungus gnats around the plant saplings following treatment over 4 days. This improved the growth of the plant saplings. Selected compounds from Ocimum extract had physiologically effective binding affinity with the insect specific olfactory receptors. **Conclusion:** Ocimum extract spray is a cost effective and ecologically favourable approach for controlling fungus gnats infesting plant saplings.

Key words: Fungus gnats, Ocimum extract, Ecological, Cost effective, Insect control, Fly larva, Fly repellent, Plant saplings.

INTRODUCTION

Fungus gnats are tiny flies commonly observed around household plants as the moist soil, organic contents and the tender roots of the plant provides an ideal environment to nourish their larvae.[1,2] While these flies are harmless to humans, they are often annoying when they navigate around your face. The larvae of the flies by feeding on the tender roots of the plant can impact the plant health, this is of specific concern for plant saplings as they may fail to cope and thrive from the minor root damage induced by the larvae.[3-5] Hence effective and early intervention to eradicate these flies and its larvae is necessary. Several household remedies to counter these flies are currently available. The popular measures are, 1) use of sticky materials/vinegar based fly tarps, 2) using dry compost materials intermittently to reduce the moisture levels which the larvae prefer and 3) covering the top layer of the compost with gravel, sand, grit or ornamental glass pebbles to discourage the flies from laying eggs.[6-9] Besides these household remedies, use of biological control strategies (predatory insects/larvae/plants) or chemical/natural product based pesticides are also recommended.[6-9] Among the natural product based pesticide, neem oil is shown to be very effective and safe to use.[10,11] The mechanisms of action of neem based products include 1) suffocating the insect by forming a layer of coating on the insect's body, 2) repelling the insects by stimulating their olfactory receptors, 3) disrupting the moulting/growth/development of the insect/larvae and 4) direct insecticidal/larvicidal effect. Among these mechanisms of actions, the feasibility to repel insects by stimulating their olfactory receptors is of specific interest, as this is humane and least disruptive to the ecological balance.[7,10,11] Similar to the neem, other aromatic plants may also be helpful in repelling the insects. Hence in this study we tested the efficacy of natural extract from Ocimum species in repelling the fungus gnats infesting plant saplings.

MATERIALS AND METHODS

Saplings of *Catharanthus roseus* naturally infested with fungus gnats were used in this study. A commercially available liquid formulation of natural extract from Ocimum species[12] (Zindagi Krishna Tulsi Liquid Extract®) was used. 30 µl of this liquid extract was mixed in 500 ml of tap water (Ocimum solution) and sprayed on the plant saplings twice daily from Day 0 to day 3 and only once on day 4. The plant saplings were monitored and photographed 5-6 times daily for the presence of fungus gnats flies form day 0 to day 9.

The 3D structure of olfactory receptors (PDB ID: 6C70, 6JPM, 6HHE, 6QQ4, 1OOF, 4Z45, 5DIC and 4Z39) reported in insect species were downloaded as PDB files from the protein data bank (https://www.rcsb.org/) and were optimized for molecular docking

Cite this article : Kumar A, Kumar AHS. Efficacy of Natural Extract from Ocimum Species against Fungus Gnats Infesting Plant Saplings. BEMS Reports. 2020;6(2):19-21.

Anya Kumar[1], Arun HS Kumar[2,*]

[1]St. Raphaela's Primary School, Stillorgan, Dublin, IRELAND.
[2]Veterinary Biosciences, School of Veterinary Medicine, University College Dublin, Belfield, Dublin, IRELAND.

Correspondence

Dr. Arun HS Kumar, DVM, PhD

Director Stemcology, School of Veterinary Medicine, University College Dublin, Belfield, Room 216, Dublin-04, IRELAND.

Phone no: 353 17166230;
E-mail: arun.kumar@ucd.ie

History

- Submission Date: 29-05-2020;
- Review completed: 05-06-2020;
- Accepted Date: 29-06-2020.

DOI : 10.5530/bems.6.2.6

Article Available online
http://www.bemsreports.org/v6/i2

in the Chimera software as reported before.[13-17] Molecular docking was performed to evaluate the binding affinity of two compounds (Methyl Eugenol and Ursolic Acid) reported in Ocimum extract against the olfactory receptors using AutoDock Vina and the docked protein-ligand complex were visualised using the Chimera and PyMOL v 1.8.2.0 software as reported before.[13-17]

RESULTS

The fungus gnats were observed inhabiting around the saplings stunting their growth. One the day 0, the saplings were sprayed (~ 5 ml) once with Ocimum solution (OS). Immediately after the spray the fungus gnats flew away or buried deeper into the compost, such rapid response was probably due to the stimulation of their olfactory receptors. The fungus gnats returned back 4 hrs post OS spray, hence a second OS spray was done at 5th hr after the first spray. The saplings were sprayed again similarly on Day 1 to 3 with similar observations of flies returning as before. However after the first OS spray on day 4 the fungus gnats very only sparingly observed. The saplings were sprayed with OS just once on day 4 but not thereafter and the fungus gnats were not observed until at least day 9. Hence OS spray was effective in reducing the fungus gnats from the plant saplings (Figure 1).

Significant number and regions of binding by hydrogen bonds were observed between the Ocimum compounds (Methyl Eugenol and Ursolic Acid) and the olfactory receptors (PDB ID: 6C70, 6JPM, 6HHE, 6QQ4, 1OOF, 4Z45, 5DIC and 4Z39) (Figure 2). As an exception no hydrogen bonds were observed between 6JPM and ursolic acid. The binding affinity of methyl eugenol and ursolic acid with all the insect specific olfactory receptors was observed to be very high and at physiologically relevant receptor-ligand interactions (Figure 2).

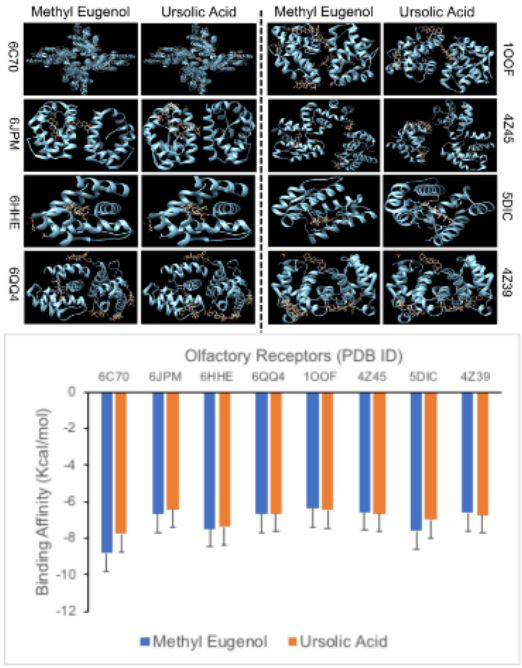

Figure 2: Binding affinity of two selected compounds (Methyl Eugenol and Ursolic Acid) from Ocimum extract against the olfactory receptors (PDB ID: 6C70, 6JPM, 6HHE, 6QQ4, 1OOF, 4Z45, 5DIC and 4Z39) assessed by molecular docking using AutoDock Vina software. The top panel shows the compounds bound by hydrogen bonds (yellow colour lines) to various regions of the respective olfactory receptors. The bottom panel shows the Mean ± SD of the binding affinity of various structural confirmations of Methyl Eugenol and Ursolic Acid against respective olfactory receptors.

DISCUSSION

We report here the efficacy of Ocimum extract in repelling and reducing fungus gnats infestation from plant saplings. The effect of the Ocimum extract was instantaneous and sustained. Such an instantaneous effect is possible when the extract is either highly toxic or can strongly stimulate the insects olfactory system.[7,10,11] Ocimum extract is highly water soluble, relatively less oily and is extensively used by humans as an immune booster, hence it being a potent insecticidal is less likely. However Ocimum extract is highly aromatic.[12,18] Hence the possibility of stimulating the insect's olfactory system and repelling them is a possible mechanism by which efficacy of Ocimum extract was observed in our study. A single spray was effective in repelling the fungus gnats for just over 4 hr, as the flies either flew away or were observed deeply buried into the compost. However the fungus gnats returned after over 4 hrs and hence a second spray of Ocimum extract was made at the 5th hr after the first spray. We didn't observe any fungus gnats returning after the 5th day of treatment. We believe the fungus gnats which returned after over 4 hr of the spray were the ones which had buried themselves into the compost and over 4 days of treatment their number progressively declined to an extent that eventually after 5 days of treatment none were available to return back. We also believe Ocimum extract had a similar repelling effect on the larvae of the fungus gnats and kept them away from the roots of the *Catharanthus roseus* plant saplings. We did observe a significant improvement on the growth (increase in height and sprouting of additional leaves) of the *Catharanthus roseus* plant saplings over the course of treatment with Ocimum extract.

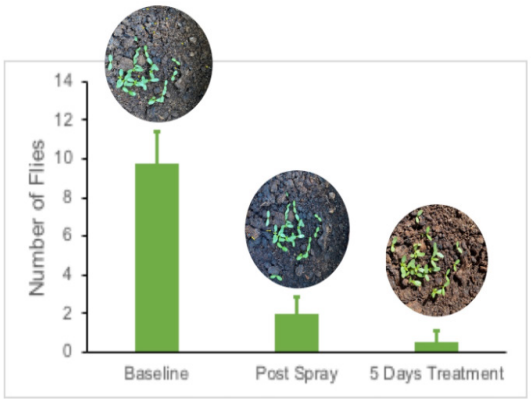

Figure 1: Effect of Ocimum extract spray on fungus gnats fly count on *Catharanthus roseus* saplings. Baseline is day 0, before the initiation of Ocimum extract spray. Post spray images were taken within 5 min after the Ocimum extract spray (from day 0 to day 4). The data is represented as Mean ± SD of 3 independent replicates with 3-4 images of each time point.

The approach of repelling the fungus gnats has significant advantage over insecticidal approach. Every living being plays its role in maintaining ecological balance, a repelling approach unlike the insecticidal approach will not interfere with maintenance of ecological balance.[2-5] Hence we see this as a significant merit of using Ocimum extract over to other methods currently recommended for the management of fungus gnats infestation of plant saplings. Moreover the aroma of Ocimum extract is very pleasant to humans, wherein by stimulating the human olfactory system it is reported to improve immunity.[12] This collateral benefits from Ocimum extract further merits its use over other methods. Besides these advantages of Ocimum extract, it is also cost effective. In our experiments to treat three small size pots planted with *Catharanthus roseus* saplings, we used under 1 ml of Ocimum extract over the 5 days of treatment. This

accounts to a total product expenditure of under 0.15 Euros. Even by any conservative estimate any of the currently recommended measure highlighted in the introduction section would have cost us over 0.15 Euros. Considering the effectiveness of the Ocimum extract to repel fungus gnats from plant saplings and its additional aromatic, ecological and economic benefits, we highly recommend its use.

CONFLICT OF INTEREST

The author declare no confllict of interest

ABBREVIATIONS

OS: Ocimum Solution.

REFERENCES

1. Cloyd RA, Zaborski ER. Fungus gnats, *Bradysia* spp. (*Diptera: Sciaridae*) and other arthropods in commercial bagged soilless growing media and rooted plant plugs. J Econ Entomol. 2004;97(2):503-10.
2. Suetsugu K, Sueyoshi M. Specialized pollination by fungus gnats in the introduced population of *Aspidistra elatior*. J Plant Res. 2018;131(3):497-503.
3. Cloyd RA. Ecology of Fungus Gnats (*Bradysia* spp.) in Greenhouse Production Systems Associated with Disease-Interactions and Alternative Management Strategies. Insects. 2015;6(2):325-32.
4. Jakovlev J, Salmela J, Polevoi A, *et al*. Recent noteworthy findings of fungus gnats from Finland and Northwestern Russia (*Diptera*: *Ditomyiidae, Keroplatidae, Bolitophilidae* and *Mycetophilidae*). Biodivers Data J. 2014;(2):e1068.
5. Mochizuki K, Kawakita A. Pollination by fungus gnats and associated floral characteristics in five families of the Japanese flora. Ann Bot. 2018;121(4):651-63.
6. Cloyd RA, Dickinson A, Kemp KE. Effect of diatomaceous earth and *Trichoderma harzianum* T-22 (Rifai strain KRL-AG2) on the fungus gnat *Bradysia* sp. nr. *Coprophila* (*Diptera: Sciaridae*). J Econ Entomol. 2007;100(4):1353-9.
7. Cloyd RA, Marley KA, Larson RA, *et al*. Repellency of naturally occurring volatile alcohols to fungus gnat Bradysia sp. nr. *Coprophila* (*Diptera: Sciaridae*) adults under laboratory conditions. J Econ Entomol. 2011;104(5):1633-9.
8. Meers TL, Cloyd RA. Egg-laying preference of female fungus gnat *Bradysia* sp. nr. *coprophila* (*Diptera: Sciaridae*) on three different soilless substrates. J Econ Entomol. 2005;98(6):1937-42.
9. Meers TL, Cloyd RA. Quantitative sampling method for fungus gnat (*Diptera: Sciaridae*) eggs in soilless growing media. J Econ Entomol. 2005;98(4):1399-403.
10. Anjali CH, Sharma Y, Mukherjee A, *et al*. Neem oil (*Azadirachta indica*) nanoemulsion--a potent larvicidal agent against *Culex quinquefasciatus*. Pest Manag Sci. 2012;68(2):158-63.
11. Scudeler EL, Garcia AS, Pinheiro PF, *et al*. Neem oil (*Azadirachta indica* A. Juss) affects the ultrastructure of the midgut muscle of *Ceraeochrysa claveri* (Navas, 1911) (*Neuroptera: Chrysopidae*). Acta Histochem. 2017;119(1):84-91.
12. Mondal S, Mirdha BR, Mahapatra SC. The science behind sacredness of Tulsi (*Ocimum sanctum* Linn.). Indian J Physiol Pharmacol. 2009;53(4):291-306.
13. Goothy SSK, Kumar AHS. Network Proteins of Angiotensin-converting Enzyme 2 but Not Angiotensin-converting Enzyme 2 itself are Host Cell Receptors for SARS-Coronavirus-2 Attachment. BEMS Reports. 2020;6(1):1-5.
14. Kumar AHS. Molecular Docking of Natural Compounds from Tulsi (*Ocimum sanctum*) and neem (*Azadirachta indica*) against SARS-CoV-2 Protein Targets. BEMS Reports. 2020;6(1):11-3.
15. Kumar AHS. Pharmacology of Chloroquine: Potential Mechanism of Action against Coronavirus. BEMS Reports. 2020;6(1):9-10.
16. Kumar AHS, Sharma V. Acetamido-Propanoic Acid Derived Compounds as Protease Inhibitors to Target Coronaviruses. BEMS Reports. 2019;5(2):20-2.
17. Sagar VK, Kumar AHS. Efficacy of Natural Compounds from *Tinospora cordifolia* against SARS-CoV-2 Protease, Surface Glycoprotein and RNA Polymerase. BEMS Reports. 2020;6(1):6-8.
18. Bansal S, Narnoliya LK, Mishra B, *et al*. HMG-CoA reductase from Camphor Tulsi (*Ocimum kilimandscharicum*) regulated MVA dependent biosynthesis of diverse terpenoids in homologous and heterologous plant systems. Sci Rep. 2018;8(1):3547.

Cite this article : Kumar A, Kumar AHS. Efficacy of Natural Extract from Ocimum Species against Fungus Gnats Infesting Plant Saplings. BEMS Reports. 2020;6(2):19-21.