



BIO-EFFICACY OF INDIAN WEED PLANTS *LANTANA CAMARA* ON COTTON MEALY BUG (*PHENACOCOCCUS SOLENOPSIS*)

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Abstract

Chemical and synthetic pesticide are persistence in nature as well as harmful to flora and fauna. Natural management of pests has always been an alternative however their efficacy, preparation, dosage are being widely studied and search of plant based pesticide is a suitable alternative. *L. camara* is weed with insecticidal activities and also has medicinal values. In this research we have studied methanol extracts of *L. camara* and their solvent fraction against to Cotton mealy bug (*Phenacoccus solenopsis*). The crude extract of *L. camara* shows lowest mortality (46.6%) at 0.01 % dose and highest mortality (93.3%) at 0.5% dose. The LD₅₀ and LD₉₀ estimated for crude extract was at 0.016% and 0.258 % respectively with fiducial limits of 0.005-0.028 and 0.125 to 0.972. Study infers use of crude extracts for the management of Cotton mealy bug (*Phenacoccus solenopsis*).

Keywords : *Phenacoccus solenopsis*, *L. camara*, weed plants.

Introduction

Common use of pesticides in modern agriculture and public health operation systems has resulted in serious environmental problems (Minelli and Rebeiro 1996; Waliszewski *et al.*, 1999). Recently, the interest in the use of plant products has increased; because of cost effectiveness, and low mammalian toxicity (Subramanyam and Roesli, 2000). Farmers and Researchers often claim successful use of plant materials in insect pest control including ash (Ajayi *et al.*, 1987), vegetable oils (Sahayaraj, 2008) and powders of plant parts (Lajide *et al.*, 1998). Examination of indigenous local herbs and plant materials have also been reported from different country viz.; India (Ahmad and Beg, 2001), Australia (Cox *et al.*, 1998), Argentina (Penna *et al.*, 2001) and Finland (Rauha *et al.*, 2000).

The search for natural products to control destructive insects and vectors of diseases is desirable due to the prevalent occurrence of vector resistance to synthetic insecticides (Cheng *et al.*, 2009). An alternative to conventional chemical control is the utilization of natural products from plant and essential oils (De Morais *et al.*, 2007). The search for plant-derived chemicals that have potential use as crop protectants (insecticides, antifeedants, and growth inhibitors) often begins with the screening of plant extracts (Ho *et al.*, 1997). There is imperative need for the development of safer, alternative crop protectants such as botanical insecticides utilized in the development of environmentally safe methods for insect control (Sadek, 2003). The application of biopesticides fits the modern strategy of integrated pest management (IPM) (Matthews, 1999), which combines all suitable control techniques harmoniously with one another and integrates them with other crop production practices, to suppress pest populations below economic injury levels, while maintaining the integrity of the ecosystem. In this study we evaluate the different solvent extracts plant, *L. camara*, against to cotton mealy bug, *Phenacoccus solenopsis* for their contact toxicity. *L. camara*, also known as wild sage, is a thorny multi-stemmed,

deciduous shrub with an average height of 2m (6ft) (Priyanka & Joshi 2013). Leave of *Lantana* is rich in various active constituents that exhibit excellent antimicrobial, fungicidal, insecticidal, nematicidal, biocidal activity (Mishra *et al.*, 2014). Essential oil obtained from the leaves of *L. camara* showed adulticidal activity against important vectors of malaria, dengue, dengue hemorrhagic fever, yellow fever and chikungunya (Dua *et al.*, 2010). *Phenacoccus solenopsis* Tinsley (Hemiptera: Sternorrhyncha: Coccoidea: Pseudococcidae) has been reported from 35 localities of various ecological zones of the globe (Ben-Dov *et al.*, 2009). In India, reports of mealybugs on cotton were made at Gujarat during the 2004-05, 2005-06, and 2006-07 crop seasons although species identity as *P. solenopsis* could be established only during 2008 (Jhala and Bharpoda, 2008).

Material and Method

Plant Material

Plant materials were collected from nearby area of Amity University campus Noida India, and authenticated by Prof. of University of Delhi, India. Plant materials were washed to remove any dirt's or contaminants and dried in the shade for few days. Dried plant materials were grounded to obtain powder methanol extract of the plant was obtained by taking 100 g of dried powder in a separate for container.

With this 300 ml of methanol was added and kept for 24 h with periodic shaking then filtered and the filtrate was collected. This procedure was repeated three times with fresh volume of methanol. The filtrates were pooled concentrated separately by Rotary vacuum evaporator at 50-60°C and evaporated to dryness. The extract thus obtained was stored in refrigerator 4°C until further use. Crude extract of plants were dissolved in distilled water. The resulting solution was thick and heterogeneous. The prepared solution was then fractionated with hexane and chloroform (Okoye and Osadebe-2009). Each solution obtained was stored in a clean amber colour bottle at 4°C for future research plan.

Insect Culture

We choose cotton mealy bug because these are large geographical area both tropical and temperate region. These are many crop specially cotton whose are most susceptibly crop. These insect collected from ground to lab for bio efficacy test.

Bio-efficacy studies

The toxicity of *L. camara* was tested against larval stages of cotton mealy bug, *Phenacoccus solenopsis*. In first stage, crude extract of the plant was tested with varying concentrations of 0.01, 0.03, 0.05, 0.07, 0.1 and 0.5 %. The concentration was prepared from 2% stock solution using emulsified water (5% tween-80). Cotton leaves collected from fields were washed thoroughly with tap water followed by distilled water and let it dry till excess water gets evaporated. The dosage prepared was used to treat cotton leaves by dipping them in respective dosages in different petri-dishes. Agar slant was used to bury petioles of the leaves to protect them from dying. Ten numbers of larva released in each petri dish for 24 hours and data on mortality of larvae were recorded for each does as well as control. Each experiment was conducted in triplicates. The percent mortality was calculated by adopting the method explained by Abbott, 1925. Further the hexane fraction (0.007, 0.009, 0.01, 0.03, 0.05, 0.07, 0.1 and 0.5 %) and chloroform fraction

(0.01, 0.03, 0.05, 0.07, 0.1 and 0.05 %) were also studied to know the activity gradient in each dosage as well as fraction. Data for each studies were recorded carefully and analysed using MS excel and PoloPlus.

Results and Discussion

The crude extract of *L. camara* shows lowest mortality (46.6 %) at 0.01 % dose and highest mortality (93.3%) at 0.5% dose (Table 1). Further, hexane fraction of the *L. camara* shows lowest (36.6%) at 0.007% and highest (76.6%) at 0.5% dose (Table 2). Similarly, the chloroform fraction shows lowest (36.6%) at 0.01 % and highest (70%) mortality at 0.5% dose (Table 3). The LD50 and LD90 data obtained for crude (0.016% and 0.258 % respectively) at fiducial limits of 0.005-0.028 and 0.125 to 0.972. Hexane fraction of the plant extract shows LD50 at 0.044% (fiducial limit 0.017-0.120) and LD90 at 9.26% (fiducial limit 1.249-11.782). The chloroform fraction of the plant extract shows LD₅₀ at 0.845 (fiducial limit 0.125-0.322) and LD90 at 1.509% (fiducial limit 0.690-6.699).

Best mortality in terms of LD50 is shown by crude extract that is at 0.016% followed by hexane fraction and chloroform fraction that is 0.044% and 0.182 % respectively (Table 4). We obtained chi square test 1.578, 0.095, 0.845 in different concentration (Crude extracts, hexane fraction and chloroform fraction) (Table-4)

Table 1: Crude extract of *Lantana camara* on cotton mealy bug (*Phenacoccus solenopsis*)

Concentration (%)	R1	R2	R3	(Average Mortality) (%)
0.5	10	9	9	93.3
0.1	9	9	8	86.6
0.07	9	9	6	80.0
0.05	8	7	7	73.3
0.03	7	4	6	56.6
0.01	6	5	3	46.6
Control	0	2	0	6.66

Table 2 : Hexane fraction of *Lantana camara* on cotton mealy bug (*Phenacoccus solenopsis*)

Concentration (%)	R1	R2	R3	(Average Mortality) (%)
0.5	9	7	7	76.6
0.1	7	5	5	56.6
0.07	5	6	5	53.3
0.05	5	5	5	50.0
0.03	4	5	5	46.6
0.01	5	4	4	43.3
0.009	5	4	3	40.0
0.007	4	4	3	36.6
Control	0	1	0	3.3

Table 3: Chloroform fraction of *Lantana camara* on cotton mealy bug (*Phenacoccus solenopsis*)

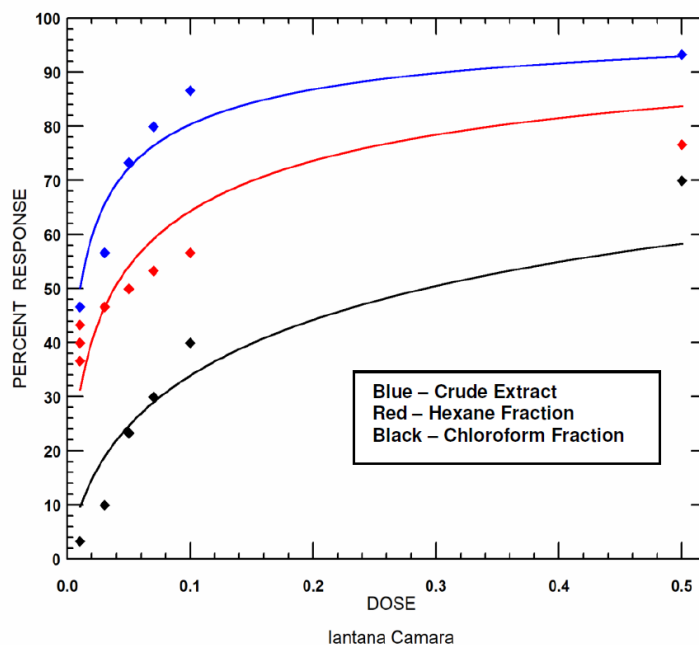
Concentration (%)	R1	R2	R3	(Average Mortality)(%)
0.5	7	6	8	70.0
0.1	4	5	3	40.0
0.07	4	2	3	30.0
0.05	4	2	1	23.3
0.03	1	1	1	10.0
0.01	0	1	0	3.3
Control	0	0	0	0.0

Table 4: LD₅₀ and LD₉₀ estimation and their analysis

S.N.	Pesticides	Chi square	Degrees of Freedom	LD ₅₀	Fiducial limits	LD ₉₀	Fiducial limits
1	Crude extracts	1.578	4	0.016	0.005 to 0.028	0.258	0.125 to 0.972
2	Hexane fraction	0.095	6	0.044	0.017 to 0.120	9.826	1.249 to 11.782
2	Chloroform fraction	0.845	4	0.182	0.125 to 0.322	1.509	0.690 to 6.669

LD₅₀ – Lethal Dose 50%LD₉₀ – Lethal Dose 90%

Currently, the trend in botanical pesticides is shifting towards propriety botanical formulations e.g., 'Universal biopesticide' formulation containing *Aloe vera*, *Lantana camara*, *Calotropis gigantea*, *Azadirachta indica* and *Vitex negundo* and garlic are effective against the mealybug (Dinesh *et al.*, 2003). A study by Sadek, 2003 has reported it to be eco-friendly and toxic to agriculturally important insect pest.

**Fig. 1 :** Mortality rate for various dosage of Crude extract, Hexane fraction and Chloroform fraction

We obtained in Linear scale fitted curve was obtained in PoloPlus software. It can be observed that the Crude extract has the highest mortality rate among Hexane and Chloroform extract, while the lowest was obtained by chloroform extract.

The Crude obtained from the *L. camara* was found an effective insecticidal agent against the *Phenacoccus solonopsis*. It is found highly toxic to Aphides (cotton mealy bug). The half of the larval mortality of aphides was observed at lower concentration of 0.016% of crude of extract of *L. camara* within 24-hours of exposure indicates the high toxicity of the product. Chandel *et al.* tested eight plant species under lab and field conditions. They found that *L. camara* at 2% extract caused 79.4% mortality of the cabbage aphid *Brevicorne brassicae* (Homoptera: Aphididae) after 72 hours in the field. Srivastava & Guleria (2003) found that the leaves of plant *L. camera* have shown mortality 22.16 % on Mustard Aphid (*Lipaphis erysimi* (Kalt)). The leaves and flowers of that *L. camara* after drying can be extracted with water and used to control many in insects including Helopeltis, aphids (Mamun and Ahmed, 2011).

Lantana camara had mortality rate of 69.32±4.50 in 24 hours, 76.34±4.30 for 48 hour and 79.8±4.83 in 72 hours for the green peach aphid caused by the acetone plant extracts. (Madanat *et al.*, 2017). *L. camera* show mortality of 1% extract shows 10.00 (14.99) in 24 hours; 20.00 (26.07) in 48 hours; 46.67 (43.07) in 72 hours on insect *M. persicae* and 16.67 (19.92) 24 hours 30.00 (32.29)48 hours 46.67 (42.99) 72 hours on *B. brassicae* (Yadav & Patel 2017).

References

- Ahmad, I. and Beg, A.Z. (2001). Antimicrobial and phytochemical studies on 45 Indian medicinal plants against multi-drug resistant human pathogens. *Journal of ethnopharmacology*, 74(2): 113-123.
- Ajayi, O.J.T.; Arokoyo, J.T.; Nesan, O.O.; Olaniyan, M.; Ndire Mbula, M. and Kannike, O.A. (1987). Laboratory assessment of the efficacy of some local plant materials for the control of storage insect pests. *Samaru Journal of Agricultural Research*, 5: 81-85
- Ben-Dov, Y.; Miller, D.R. and Gibson, G.A.P. (2009). ScaleNet: A Searchable Information System on Scale Insects. Available on-line at <http://www.sel.barc.usda.gov/scalenet/scalenet.htm>. Accessed 8 August 2009
- Chadel, B.S.; Gupta, R.; Sachan, N. and Dubey, A. (2007). Aphidicidal activity of certain naturally occurring indigenous plant extract against cabbage aphid *Brevicoryne brassicae* Linn. *Indian Journal of Entomology*, 69(2): 122-126.
- Chandel, B.S.; Singh, V. and Trevedi, S.S. (2012). Aphidicidal potential of *Azadirachta indica*, *Adhatoda vasica*, *Vitex negundo*, *Parthenium hysterophorus* and *Lantana camara* against mustard aphid, *Lipaphis erysimi* Kaltbach (Hemiptera: Aphididae). *Journal of Applied and Natural Science*, 4(2): 181-186.
- Cheng, S-S.; Liu, J-Y.; Huang, C-G.; Hsui, Y-R.; Chen, W-J.; Chang, S-T. (2009a). Insecticidal activities of leaf essential oils from *Cinnamomum osmophloeum* against

- three mosquito species. *Bioresource Technology*, 100: 457–464.
- Cox, S.D.; Gustafson, J.E.; Mann, C.M.; Markham, L.; Liew, Y.C.; Hartland, R.P.; Bell, H.C.; Warmington, J.R. and Wyllie, S.G. (1998). Tea tree oil causes K⁺ leakage and inhibits respiration in *Escherichia coli*. *Letters in Applied Microbiology* 26, 355–358
- De Morais, S.M.; Facundo, V.A.; Bertini, L.M.; Cavalcanti, E. S. B., dos Anjos Júnior, J. F., Ferreira, S.A. and de Souza Neto, M.A. (2007). Chemical composition and larvicidal activity of essential oils from Piper species. *Biochemical Systematics and Ecology*, 35(10), 670-675.
- Dua, V.K.; Pandey, A.C. and Dash, A.P. (2010). Adulticidal activity of essential oil of *Lantana camara* leaves against mosquitoes. *Indian Journal of Medical Research*, 131(3): 434-440.
- Ho, S.H.; Ma, Y. and Huang, Y., 1997. Anethole, a potential insecticide from *Illicium verum* Hook F., against two stored product insects. *Int. Pest Control* 39 (2): 50-51
- Jhala, R.C.; Bhardoda, T.M. and Patel, M.G. (2008). *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae), the mealy bug species recorded first time on cotton and its alternate host plants in Gujarat, India. *Uttar Pradesh Journal of Zoology*, 28(3): 403-406.
- Lajide, L.C.O.; Adedire, C.O.; Muse, W.A. and Agele, S.O. (1998). Insecticidal activity of powders of some Nigerian plants against the maize weevil, *Sitophilus zeamais* Motsch. In: *Entomology and the Nigerian Economy: Research Focus in the 21st century*; ESN Occasional Publication 31, (Lale, N.E.S.; Molta, N.B.; Donli, P.O.; Dike, M.C. and Aminu-Kano, M. Maiduguri eds), Nigeria: Entomological Society of Nigeria (ESN) 227-235.
- Madanat, H.M.; Al-Antary, T.M. and Zarqa, A.M. (2017). Bioactivity of six acetone plant extracts against the green peach Aphid *Myzus persicae* Sulzer (Homoptera: Aphididae). *Fresen. Environ. Bull*, 26: 3340-3349.
- Matthews, G.A. (1999). Pesticides, IPM and training. *Phytoparasitica*, 27(4): 253–256.
- Minelli, E.V. and Rebeiro, M.L. (1996). DDT and HCH residues in the blood serum of malaria control sprayer. *Bull. Environ. Contam. & Toxicol.* 57: 691 - 696
- Mishra, A. (2014). Allelopathic properties of *Lantana camara*: A review article. *International journal of innovative research and review*, 2(4): 32-52.
- Okoye, F.B.; Odimegwu, D.C.; Nworu, C.S.; Agbo, M.O.; Esimone, C.O.; Osadebe, P.O. and Proksch, P. (2016). Modulation of intracellular expression of ifn γ and IL-2 in culture of splenic T lymphocytes by some flavonoid glycosides of *Alchornea floribunda*. *Pharmaceutical biology*, 54(9): 1873-1880.
- Penna, C.; Marino, S.; Vivot, E.; Cruan \tilde{e} s, M.C.; de Mun \tilde{e} oz, J.D.; Cruan \tilde{e} s, J.; Ferraro, G.; Gutkind, G. and Martino, V. (2001). Antimicrobial activity of Argentine plants used in the treatment of infectious diseases. Isolation of active compounds from *Sebastiania brasiliensis*. *Journal of Ethnopharmacology*, 77: 37–40.
- Priyanka, N. and Joshi, P.K. (2013). A review of *Lantana camara* studies in India. *International Journal of Scientific and Research Publications*, 3(10): 1-11.
- Rauha, J.P.; Remes, S.; Heinonen, M.; Hopia, A.; Kähkönen, M.; Kujala, T. and Vuorela, P. (2000). Antimicrobial effects of Finnish plant extracts containing flavonoids and other phenolic compounds. *International journal of food microbiology*, 56(1): 3-12.
- Sadek, M.M. (2003). Antifeedant and toxic activity of *Adhatoda vasica* leaf extract against *Spodoptera littoralis* (Lep., Noctuidae). *Journal of applied entomology*, 127(7): 396-404.
- Sahayaraj, K. (2008). Common plant oils in agriculture and storage pests management. *Green Farming*, 1(2): 48-49.
- Srivastava, A. and Guleria, S. (2003). Evaluation of botanicals for mustard aphid, *Lipaphis erysimi* (Kalt.) control in Brassica. *Himachal J. Agric. Res*, 29(2): 116-118.
- Subramanyam, B. and Roesli, R. (2000). Inert dusts. In *Alternatives to pesticides in stored-product IPM* (pp. 321-380). Springer, Boston, M
- Waliszewski, S.M.; Aguirre, A.A.; Benitez, A.; Infanzon, R.M.; Infanzon, R. and Rivera, J. (1999). Organochlorine pesticide residues in human blood serum of inhabitants of Veracruz, Mexico. *Bulletin of environmental contamination and toxicology*, 62(4): 397-402.
- Yadav, S.K. and Patel, S. (2017). Insecticidal and repellent activity of some plant extracts against *Myzus persicae* (Sulzer) and *Brevicoryne brassicae* (Linnaeus). *Journal of Entomology and Zoology Studies*, 5(2): 1434-143.