Pesticide activity of six medicinal plant specie extracts against *Pauropsylla tuberculata* Crawford.

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ABSTRACT

Galls are any deviation in the normal pattern of plant growth produced by a specific reaction to the presence and activity of a foreign organism, such as an animal or plant parasite. Psyllid *Pauropsylla tuberculata* causes leaf gall disease in *Alastonia scholaris*. The object of study was to evaluate the efficacy of plant-derived extracts against *Pauropsylla tuberculata*-induced galls on *Alstonia scholaris*. Field trials were conducted using ethanolic leaf and petroleum ether seed extracts from six plant species, such as *Annona squamosa*, *Albizia lebbek*, *Lantana camara*, *Pongamia pinnata*, *Eucalyptus globulus*, and *Limonia acidissima*, applied as neem oil-based emulsions. This study showed that *Lantana camara* leaf extract was 22.70% effective as to repellent activity against *Pauropsylla tuberculata*. These findings support the use of botanical extracts as eco-friendly alternatives to synthetic pesticides.

Keywords: Galls Disease, Leaf Extract, Field trials, Biopesticide, *Pauropsylla tuberculata, Alstonia scholaris*.

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INTRODUCTION

There are various types of pests which depends on plants to complete their life cycle. In this process they infect plants and causes plant diseases. The infection affects the structure, shape, growth and developments of plants. To keep plants free from these pests' toxic chemical-based pesticides are used at large scale. These pesticides have adverse effects on soil, water and air. There are several types of psyllid species are reported which causes galls disease of plants. To prevent and cure of diseased plants from these psyllids' toxic chemical-based pesticides are used. The development of botanical based pesticides is an alternative and safer option. The use of plant-based pesticides is comparatively less harmful and valuable. The plant parts such as flower, seed, leaves and fruits contain several classes of bioactive molecules and have potential to act as attractant, fungicide and pesticides (Augusto *et al.,* 2021). *Alastonia scholaris* is a medium to large shrub plant grows in throughout India. The bark is greyish in color and contains different types of secondary metabolites. One of the most important alkaloids present in the plant is called alstonine which was reported to have anti-cancerous property, apparently reflecting its medicinal value as reported (Datta and Dhiman, 2016). The tree shows adaptability and high tolerance against pollution. The gall insect *pauropsylla tuberculata,* is species specific to the host plant and completes their life cycle around that host only (Bandana and Tripathy, 2020). *Pauropsylla tuberculata* induces gall formation on part such as leaves, stem, fruits inflorescence, etc of this highly valuable tree which adversely affects its looks and economic value (Dhiman *et al.,* 2012, Chander, 2014). Gall formation by *Pauropsylla tuberculata* reduces the aesthetic and medicinal value of *Alstonia scholaris*, necessitating eco-friendly pest control methods. Available scientific literature indicates that a number of plants or some of their parts contain poisonous

elements with insecticidal, antihelimintic or antifungal properties. Though several combinations of botanical pesticides have been tested either in isolation or with other substances, a wide range of toxic plants of forestry origin remains to be studied for their pesticidal properties and probability of their large-scale use. Plant extract contained many important substances which can be used as pesticides and inhibit the life cycle of disease causal organism (Ni *et al.,* 2021, El khetabi *et al.,* 2022). The development of plant-based biopesticides as a sustainable solution in contemporary agriculture has been fueled by the growing need for environmentally benign substitutes for synthetic pesticides. These biopesticides, which come from botanical sources, include plant extracts, essential oils, and secondary metabolites (Shaizee *et al.,* 2025). The literature reviewed, identified 95 plants extract with insecticidal activity (Wilson *et al.,* 2021) The effect of ethanolic extracts of plants against fungal pathogen previously reported (Pathak and Arjaria, 2019). There are many plants from forest origin such as- *Annona squamosa, Albizia lebbek, Lantana camara, Pongamia pinnata, Eucalyptus globulus, Limonia acidissima,* reported to contain bioactive molecules in plant part including leaf, flower, seed, and fruit and have potential to act as pesticide. These bioactive molecules may kill or inhibit the growth of psyllids. While plant extracts have shown pesticidal properties, their efficacy against *Pauropsylla tuberculata* remains underexplored. The aim of study is to evaluate the efficacy of ethanolic leaf and petroleum ether seed extracts from six plant species against *Pauropsylla tuberculata*. The mode of action was observed as repellent activity on *Pauropsylla tuberculata*.

METHODOLOGY

Host Plant

The present study was carried out in the Forest Research and Extension Circle Institute, Indore, Madhya Pradesh. In which different types of seedlings of other species along with *Alastonia scholaris* are grown in polybags. *Alastonia scholaris* evergreen tropical tree belongs to the apocynaceae family. The leaves are shiny and dark green in color. Leaves are entire, elliptic, sub coriaceous, obovate and have smooth surface. Leaves are arranged in whorls of 4-8 leaflets. Flowers are pale yellow in color. The psyllid, *Pauropsylla tuberculata* Crawf, forming galls on leaves of *Alastonia scholaris,* which tend to impart ugly look to the tree. The leaf galls are spherical, oval to ellipsoidal, solid hard, rough, dark and persistent (Stone *et al.,* 2003). The galls are found on upper and lower surface of the leaves (Fig.1 and Fig.2). The mmaximum number of galls on the leaves is observed on the dorsal side near the midrib and side veins.

Test plants

For this, commonly found plants were selected. The basis of selection was the chemicals found in them, which were described in previous research studies. Samples of test plant such as - *Annona squamosa* L., *Albizia lebbek* (L.) Benth., *Lantana camara* (L.), *Pongamia pinnata* (L.) Pierre, *Eucalyptus globulus* Labill., *Limonia acidissima* L. were collected from different places of Indore district. The coordinates are about 22.72° north latitude and 75.86° west longitude. The seed of *Annona squamosa, Pongamia pinnata* and the leaves of *Annona squamosa, Albizia lebbek, Lantana camara, Eucalyptus globulus* and *Limonia acidissima* were collected and processed.

Extraction and Dose administration

The leaves and seeds of the test plants were air-dried for six to seven days. After that, the plant parts were pulverized into powder with the help of mixer grinder. Plant parts were extracted with the help of a soxhelt extractor. To prepare the extract, 100 gm of plant parts were taken in a flask and extracted with 200ml of solvent. Leaves powder is extracted by ethanol, and seed powder is extracted by petroleum ether with multiple extraction cycles. After complete extraction, extracts were dried with the help

of a boiling water bath. A neem oil-based solution (0.5% w/v) was prepared to spray on infected plants. 5 gm of prepared leaf and seed extracts were mixed with 1000ml base solution and sprayed on infected plants.

Trials were done at Green Net House. The test was conducted after the rainy season (August- September). During this time the temperature was around 30-35^{0}C, and there was high humidity in the air. Trials of different formulations were done on gall-infected plants of *Alastonia scholaris*. The three rows of ten blocks of plants were formed for treatment, including control and observing the effect of formulation. The number of plants per block was 50. The blocks were treated with different soxhelt leaf and seed extracts, and their effect was observed on diseased leaves (Pathak *et al.*, 2014). In a field trial, formulations with three replications on host plants were given at regular intervals throughout the week from the first day of treatment.

RESULT AND DISCUSSION

Galls are pathologically developed cells, tissues or organs of plants that have risen mostly by hypertrophy (over growth) and hyperplasy (cell proliferation) under the influence of parasitic organisms like bacteria, fungi, nematodes, psyllids or insect (Mani., 1964). The galls found on the leaves of *Alastonia Scholaris* are oval to ellipsoidal. Young and mature leaves are affected. With an increase gall in number all the leaves appear crumbled and completely deformed (Bhatnagar *et al.*, 2022). The results of the effect of leaf ethanol extracts of five plants and the seed petroleum ether extracts of two plants with aqueous based emulsion to inhibit miticidal activity of *Alastonia scholaris* presented in Table 1 and 2 and Chart 1. Effects of treatments on *Pauropsylla tuberculata* evaluated from increase in numbers of noninfected leaves after application of treatments. The analysis of variance for the effects of treatments generally indicated the plant extracts treatments significantly reduced percentage of infected leaves than the untreated during the trial seasons. Result revealed that petroleum ether seed extracts of *A. indica*, *A. squamosa* and *P. pinnata* and ethanolic leaf extract of *A. squamosa*, *A. lebbek*, *L. camara*, *Pongamia pinnata*, *Eucalyptus globulus* and *L. acidissima* with aqueous based solution found to be effective on infected plant leaves of *Alastonia scholaris*.

No treatment was applied in control section. The number of non-infected leaves were decreased in control section by 6.48%. *Lantana camara* leaf ethanol Extract found 22.70% effective to increase number of noninfected leaves. *Annona squamosa* leaf ethanol extract was found 22.37% effective on infected leaves. This was followed by *Eucalyptus globulus* and *Albizia lebbek* leaf ethanol extract by 19.74% and 10.77% effective on infected leaf. *Limonia acidissima* leaf ethanol extract found least effective on infected leaf. It resulted in an 8.85% increase in non-infected leaf. Three blocks treated with Neem oil-based solution, *Pongamia pinnata* (Karanj) and *Annona squamosa* seed extracts found 14.25%, 12.87% and 10% effective to increase number of non-infected leaves. *Lantana camara* leaf ethanol extract perform well compare to other leaf and seed extracts. The significance value (p) after apply ANOVA one way test in observed data is 0.000531. As this value is less than 0.05, in light of this null hypothesis namely "there is no significant effect of plant extracts on the number of non-infected leaves of *Alastonia scholaris"* is rejected. To observe the difference between pairs of groups post hoc test (Tukey's Test) was performed. The p value between before and after first, second, third and fourth treatment were 0.05, 0.005, 0.0008 and 0.0006 respectively.

The leaf ethanol extract of *Lantana camara* was found most effective (22.70%) against psyllid, *Pauropsylla tuberculata* and reduced percentage of infected leaves. The methanolic leaves extract of *L. camara* showed repellent and growth inhibitory effects against termites (Adlin *et al.*, 2023). *Lantana camara* has been shown to have

Table 1. Treatment on *Alastonia scholaris* (Leaf Galls) with different formulations of selected plant species

Treatment Type	Average No. of leaves in Each Block (10 Plants)				
	A	**B**	**C**	**D**	**E**
Control	118±7.54	119.66±4.50	145.66±10.5	134±2.64	134.33±4.72
Base solution	112.66±5.03	126.66±4.19	132.66±10.1	130.66±7.63	130.66±3.78
Karanj seed oil+ base Solution	113.66±4.93	112.66±7.76	121.66±5.13	121.66±5.68	126.33±9.29
Annona seed + base solution	122.33±3.51	103.66±11.15	113±13.07	118.66±14.46	119±14.73
Annona leaf+ base solution	119±5.56	126.66±11.06	147.33±6.42	140.66±2.51	145.33±9.29
Lantana leaf+ base solution	122±8	115±3	111.33±10.1	127±2	132.33±4.16
Albizia leaf+ base solution	114.33±2.51	114.33±6.11	127.66±10.96	130.66±12.50	138.33±9.50
Limonia leaf+ base solution	115.33±7.76	123.33±4.93	128.33±4.04	133.66±5.68	143±4
Eucalyptus leaf+ base solution	128.66±2.08	132.33±7.50	135.66±7.02	133.66±9.60	140.66±5.85
	Average No. of non-infected leaves in Each Block (10 Plants)				
Control	34.33±5.03	32.66±6.42	37.66±6.50	33.33±10.21	30.33±4.50
Base solution	33.66±2.88	40.33±2.51	54.33±5.50	57.33±10.69	57.66±11.23
Karanj seed oil+ base Solution	33.66±3.21	37.66±3.78	41.33±6.11	46±13.85	53.66±10.69
Annona seed + base solution	33±2.64	29.66±4.72	32.66±4.16	45.33±8.50	44±12.16
Annona leaf+ base solution	35.33±1.15	55.66±6.65	67.66±14.18	66.66±13.57	75.66±12.58
Lantana leaf+ base solution	35±3.60	51±3.60	48±5.19	62.66±9.23	68±5.29
Albizia leaf+ base solution	30.66±6.42	29.33±7.50	39.33±5.85	47.66±±10.69	52±10.58
Limonia leaf+ base solution	30.66±3.78	33.66±7.50	31.66±11.93	36.33±8.02	50.66±6.65
Eucalyptus leaf+ base solution	34.66±5.50	32.66±4.50	43.33±8.38	41.33±13.05	65.66±4.16

Where A= before Treatment, B=After 7days, C= After 14 days, D=After 21 days, E= After 28 days, ±= Standard error.

insecticidal properties against *Dysdercus koenigii* (Kayesth *et al.,* 2020). The effect of *L. camara* essential oil against development of *Chrysomya megacephala* previously reported (Maddheshiya and Singh, 2021). The presence of bioactive molecules has been reported by phytochemical analysis of *Lantana camara* (Sushama, 2017). The synthesized AgNPs exhibited good antibacterial activity when tested against *Escherichia*

Table 2. Effect of various treatments on non-infected leaves of *Alastonia scholaris*

Treatment Type	Average percentage of non-infected leaves					Effect of Treatment (%)
	A	B	C	D	E	
Control	29.06	27.29	25.85	24.87	22.58	6.48 Decrease
Base solution	29.88	31.84	40.95	43.87	44.13	14.25 Increase
Pongamia seed+ base Solution	29.61	33.43	33.97	37.8	42.48	12.87 Increase
Annona seed + base solution	26.97	28.61	28.9	38.2	36.97	10 Increase
Annona leaf+ base solution	29.69	43.94	45.92	47.39	52.06	22.37 Increase
Lantana leaf+ base solution	28.68	44.34	43.11	49.34	51.38	22.70 Increase
Albizia leaf+ base solution	26.82	25.58	30.8	36.47	37.59	10.77 Increase
Limonia leaf+ base solution	26.58	27.29	24.67	27.18	35.43	8.85 Increase
Eucalyptus leaf+ base solution	26.94	24.68	31.94	30.92	46.68	19.74 Increase

coli, *Pseudomonas* spp., *Bacillus* spp.
and *Staphylococcus* spp. using standard Kirby–Bauer disc diffusion assay. Furthermore, they showed good catalytic activity on the reduction of methylene blue by *L. camara* extract which is monitored and confirmed by the UV–Vis spectrophotometer (Ajitha *et al.,* 2015). The insecticidal properties of macerated plant extracts of genus Compositae, Meliaceae, Staphyleaceae, and Actinidiaceae against *Coptotermes gestroi* and *Spodoptera litura* were reported (Meisyara *et al.,* 2019). The leaf and seed extracts of *Annona squamosa* were found 22.37% and 10% effective against *Pauropsylla tuberculata.* The previous work also resulted in the insecticidal activity of *Annona squamosa* leaf extract against *Aedes aegypti, Nasutitermes corniger*, and *Sitophilus zeamais* and the microcrustacean *Hyalella* species (Lucas *et al.,* 2023). Deshmukhe *et al.,* (2010) reported that both seed and leaf applications of cold alcohol extract of *Annona squamosa* are highly effective in controlling the lepidopteran pest, *S. litura.* Methanolic extract of *Manilkara zapota, Annona squamosa* and *Tamarindus indica* seeds were found effective against *X. campestris* (Uma *et al.,* 2012). *Albizia lebbek* leaf extract were found 10.77%, third most effective in leaf extracts of test plants. The methanolic extract of *Albizia procera* have allelopathic activity and can be used as bioherbicide to control weeds (Hosan and Nogouchi, 2022). The insecticidal and piscicides properties of the leaves of *Albizia procera* reported (Sivakrishnan and Kavitha, 2018). The result represented that Eucalyptus leaf extract also effective against aphid, *pauropsylla tuberculata.* The result of present study was also supported (Mehwish *et al.,* 2023). Their study resulted that the Neem seed, garlic, eucalyptus and tobacco plant extract have antifeedant activity against jassids, aphids and white flies. Leaf extract of *Limonia acidissima* inhibited activities of psyllids. The aqueous *Limonia acidissima* leaf extract-based nanoparticles have antibacterial, antifungal and antioxidant activity (Ponnusamy *et al.,* 2022). Antimicrobial activities of methanol and acetone extract of *Limonia acidissima* also reported (Islam *et al.,* 2020). Different concentrations of leaf aqueous and ethanol extracts of *Calotropis procera, Ipomoea carnea*, and *Thevetia peruviana* tested against the gall-inducing insect *Eriophyes cheriani massee* on the host plant *Pongamia pinnata* (Pathak *et al.,* 2014). The present study was an important step to protect or inhibit the growth of psyllids on plants, with the use of plant based miticides. These botanical based formulations are ecofriendly and cost effective. Now we are concluded that the leaf extract of *Annona squamosa, Albizia lebbek, Lantana camara, Eucalyptus globulus, Limonia acidissima* and the seed extracts of *Annona squamosa, Pongamia pinnata* effective to inhibit the psyllid's activity to spread the galls. The use of natural plant based miticide provide an opportunity to avoid synthetic chemicals and offer novel

approach to the management of galls disease of plants. As per the recent literature reviewed, this is the first time when the effect of leaf and seed extracts against *Pauropsylla tuberculata* was proved in the field study. The present study indicates *Lantana camara* leaf ethanol extract was much effective against *Pauropsylla tuberculata* compare to other leaf extract. These extracts offer a sustainable alternative for gall management, but further studies are needed to optimize formulations and identify active compounds.

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