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Interplay Between Natural Compounds of *Mundulea sericea* Bark Extract in Combating *Aleurodicus dispersus*, Spiralling Whitefly an Invasive Pest of Telangana

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A B S T R A C T

An invasive pest, Spiralling whitefly, *Aleurodicus dispersus* incidence has been noticed on Guava, Mango, papaya, Banana, coconut and pomegranate crops in Telangana, India during 2020-22,later it spread to ornamental plants. *Aleurodicus dispersus*, spiralling white fly was observed on the underside of leaves along with the presence of white waxy material honey dew around the whitefly infested area, sooty mould formation and drying of infested leaves observed in infected plants. By targeting the eggs of spirling whiteflies, the life cycle and the population of *Aleurodicus dispersus* is reduced. This is the first study in Telangana to examine the efficacy of *Mundulea sericea* bark and leaves as a ovicidal agent against spiralling whitefly that is a major threat to Agriculture and Horticulture crops, after exposing the plant extract for 24 hrs egg mortality was observed. This discovery has significant implications for pest control, its a eco-friendly alternative to synthetic chemical insecticides.

Introduction

The welfare of humans is reliant on ecological sources. Spiral whitefly damage has resulted in significant losses in horticultural and decorative crop production. Due to their ravenous eating habits, the spiraling whitefly, *Aleurodicus dispersus* Russell (Hemiptera: Aleyrodidae), severely damages a variety of crop kinds (Aiswariaya *et al.,* 2007; Bryne *et al.,* 1990).

The most widely used insecticides are chemical and plant-based treatments; however, insect pests have evolved a resistance to several common conventional pesticides worldwide (Denholm *et al.,* 1996). The production of guava, papaya, bananas, custard apples, and jackfruit is seriously threatened by severe infestations of this pest, which cause direct damage to the plant by taking sap from the leaves, which stunts growth, weakens plants, and lowers agricultural yield (Pullaih and Silar Mohammad, 2014). Numerous plant species worldwide remain unexplored in terms of phytochemistry. Roughly 2% of the 5,00,000 plant species have been studied phytochemically.

To find numerous phytochemicals, it is therefore important to conduct phytochemical analyses of different plant species. With almost 500 species, Studies on species from the state of Andhra Pradesh are quite rare.

Therefore, the goal of the current study is to qualitatively screening the leaves and bark of extracts from the Telangana region.

Morphology of *Aleurodicus dispersus*

The developmental biology of *Aleurodicus dispersus* Russel, has been investigated. It was found to have a cumulative developmental period of (23 - 41) days. The mean numbers of egg developing to adult have been found to be 138.1 per thousand eggs. The spread of the insect has been found to be connected to human traffics. The oviposition and feeding occurs simultaneously and occurred more on their abaxial surface of host leaves. Rainfall and temperature played a prominent role on the abundance and seasonal fluctuation of the insect and infact, regulating their population (Lopez, et al., 1997; Laprade and Gerdas, 1998).

Biology

A. dispersus fed on plants by sucking plant juices from the phloem through a slender stylet as other whiteflies do (Megir-Gumbek, 1987) and the resultant honeydew excretions that fall on surfaces below colonies often develop a layer of sooty mould. The newly hatched nymph had functional legs and moves about before settling to feed, the second instar nymphs flattens out on the leaf whose legs and antennae become vestigial (that is, it is sessile) and cottony secretion was sparse, the third instar larva resembled the previous instar in shape but slightly larger as found in other whiteflies (Berlinger, 1980, 1986; Bryne *et al.,* 1990; Verma, 1992).

Level of Infestation Assessment

Result -Maximum infestation (85-100%): Severe incidence of *A.dispersus* (pest) on the entire tree guava tree

The observation and assessment of *A.dispersus* on guava tree, showed maximum level of infestation that ranged from 85-100 % inclusive of eggs, instar larvae and adults on all branches of the guava tree.

Grade of infestation of *Aleurodicus dispersus* on various host plant in different Seasons (from Sept 2021 to Dec 2022)

Damage is caused by the whitefly piercing the leaf and sucking the sap, when whitefly numbers are high, this leads to early death of plants. Damage is also caused by build up of sooty mould Sooty moulds (fungi) grow on the honeydew produced by the whiteflies and their nymphs as they feed. The plants do not get sufficient sunlight for normal growth.

Symptoms

- The overall vigour of the plant is lost
- distorted or damaged leaves
- yellowing or silvering of leaves
- stunted growth of plants
- premature dropping of leaves
- Honeydew /or sooty mould
- leaves rolled or folded
- Reduction in crop yield

Mundulea sericea

Mundulea sericea, the cork bush, grows in deep sandy or gravelly soil, Known for preventive and chemo therapeutic agent against inflammatory diseases and Insecticidal activity. *Mundulea sericea* is available in the outskirts of city area Hyathnagar, Rangareddy, Ibrahimpatnam and Kadthal area.

Collection of plant species

The medicinal plants were available to local villagers surrounding the forest area and also found in and around forest area of Mulugu, siddipet district and the outskirts of city area Hayathnagar, Rangareddy, Ibrahimpatnam and Kadthal area.

Phytochemical properties of *Mundulea sericea*

Mundulea sericea is known as Neelimarri in Telugu language, it is a shrub that flowers twice a year and also known for corky bark for chemo preventive and chemotherapeutic agent against inflammatory diseases and Insecticial activity.

Plant crude extraction and isolation of secondary metabolities

Standard methodologies were followed (Crude extraction-Hot water (Liu *et al.,* 2009; Thangavel Bhoopathi, *et al*., 2015) and cold water (Thao and

Baumann, 2004) for the crude extraction. Fresh and healthy leaves and bark, *M. Sericea* were collected, washed with running water several times to discard dirt and any impurities. Leaves and bark were thoroughly checked for any kind of disease, then shade dried for two weeks at 27°C (RT27 +2C°) to remove dampness.

Crispy leaves and bark were finely grinded by using electrical blender, samples were preserved in air tight Ziplock bags for subsequent utilization.

Qualitative Analysis of plant material, Soxhlet extraction

The leaves bark of the plant was dried completely 3 gms of the samples (Leaf and bark) was taken in the thimble cap and extracted constantly the secondary metabolites with various extracts such as Ethanol (90%), methanol (90%), aqueous and biochemical screening protocols executed were based on former work done with plant investigation.

The leaves and bark of *M. Sericaea* using methanol as extract was subjected to soxhlet extraction (Ulusoy and Ulgenturk, 2003). Boiling point range 65°Cfor 6h. The plant extracts were run through Rotary evaporator and the residues of leaves and bark of *Mundulea sericea* were obtained. The residues were made into stock solution and dilutions of 25, 50, 100, 200, 400 ppm were prepared.

The current research investigation was carried out in leaves and bark of *M. Sericea* findings revealed plant (leaves and Bark) are rich in carbohydrates, cardioglysides, terpenoids, alkaloids, tannins, flavonoids (Methanol extract).

Phytochemical screening results

Acute Toxicity Evaluation and Mortality

Acute toxicity can be measured by taking into account the rate of mortality after a defined period of time as the increasing toxicant dosages (Ramade, 1987). The LC50 (median lethal concentration) is the most important parameter which causes 50% deaths in the population being studied.

The eggs, Pupa and adults of *A.dispersus* were subjected to various concentrations for 24 hrs in the current investigation. The Mortality percentage was reported and statistical analysis was analyzed.

Direct Contact Method

For the evaluation of each plant extract, as per the protocol given by Chand *et al.,* (2019) 10 adult *A.dispersus*, egg and pupa were gathered from infested guava tree and were kept in petridish. Acute toxicity level of *A.dispersus* (adult, egg and pupa), methanolic botanical extracts was determined by straight contact application. 1ml of conc, 25 ppm, 50 ppm, 100 ppm, 200 ppm 400 ppm were prepared from stock solution, in replicates of 5. After 24 hours the mortality is recorded, a control was also subjected., % mortality and Statistical analysis was calculated according to Abbott's formula (1987).

GC/MS analysis of *Mundulea sericea* leaf extract detected 100 compounds. The main defined components are ten and listed in Table according to their retention times and their percentage composition.

Results and Discussion

The chromatic spectra showed corresponding peaks indicating the presence of compounds and retension time. Hence leaves and bark of *Mundulea sericaea* are insecticidal in function.

The major compounds obtained from Methanol extract of *Mundulea sericea* Leaves was found to be valuable biological control tool on the adult and pupa of *A.dispersus* compounds identified are, Bis 2 hydroxy3-Isobutylrophanate, Benzene propionic acid,3,5 bis (derivative of Isoquercetin), Di Butyl phathalate, Alphaamyrin, 9, Di,teotbutyl,oxaspir (4,5) deca,6,9 dione, hexadeconic acid, I Nonadeciene.

Insecticidal significance of isolated compounds

The seasonal incidence of spiralling whitefly *A.dispersus* indicated that the population of spiral whitefly was found to be high during Nov to March 2021, and low during summer, April and May. The detectable results of acute toxicity level, confirms (rutin, Isoquercetin and quercetin) at different concentrations (25, 50, 100, 200 and 400 ppm) had marked mortality rate, along with-Rotene,Stigmastrol2,4 Bis 4-Methoxyphenyl 2-Propylmethox,Dibutylpthalate. (*Mundulea sericea* Bark) BIS 2hydroxy 3-Isobutylrophanate, Benzene propionic acid,3,5 bis (Derivative of Isoquercetin)Di butyl phthalate, Alpha –amyryin (*Mundulea sericea* Leaves).

Table.1 Life stages of *A. dispersus*

Sr. No	Botanical Name	Common Name	Family	Grade of infestation Nov- Feb, Mar-June, July-Oct		
1	*Psidium guajava*	Guava	Myrtaceae	IV	II	I
2	*Musa sepientum*	Banana	Musaceae	IV	II	II
3	*Carcica papaya*	Papaya	Caricaceae	III	III	II
4	*Syzygium cumini.*	Jamun	Myrtaceae	III	II	I
5	*Hibiscus rosa-sinensis*	Hibiscus	Malvaceae	III	II	I
6	*Solanum lycopersicum*	Tomato	Solanaceae	IV	II	II
7	*Solanum melanogena*	Brinjal	Solanaceae	III	II	II
8	*Cocos nucifera*	Coconut	Arecaceae	IV	III	II
9	*Annonas quamosa*	Custard apple	Annonaceae	IV	III	II
10	*Capsicum frutescens*	Chilli	Solanaceae	III	II	I

Table.2 Morphometric parameters of different stages of *A. dispersus*

Stage of Whitefly	Length(mm)	Breadth (mm)
Eggs	0.27-0.29 (0.28)	0.11-0.12 (0.11)
First instar nymph	0.31-0.35 (0.33)	0.13-0.15 (0.14)
Second instar nymph	0.41-0.48 (0.44)	0.23-0.28 (0.25)
Third instar nymph	0.64-0.75 (0.69)	0.40-0.45 (0.42)
Fourth instar nymph	0.93-1.17 (1.07)	0.61-0.79 (0.71)
Adult Male	2.38-2.43 (2.40)	1.20-1.25 (1.22)
Adult female	1.80-1.90 (1.86)	1.06-1.12 (1.09)

Table.3

Plant Species	Common name	Location	Date of collection
Mundulea sericea	Cork Bush	Outskirts of city area Hyathnagar, Rangareddy, Ibrahimpatnam and Kadthal area	13 12.2021

Figure.1 Levels of infestion of *A. dispersus* seasonally

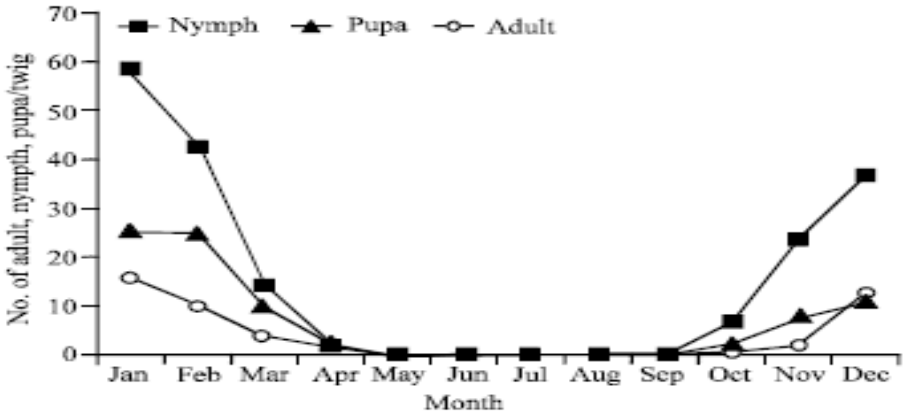


Table.4 Phytochemical screening of *Mundulea sericea*

Phytoconstituents	Types of Test	Leaf and bark extract of *Mundulae sericae*			
		Acetone	Methanol	Ethanol	Aqueous
Terpenoids	Salkowski	+	+	+	_
Alkaloids	Mayer's	+	+	-	_
Flavonoids	Sulphuric acid Test	+	+	+	+
Tannins	Ferric chloride test	+	_	+	_
Carbohydrate	Molisch's test, Fehling's test Benedict's test:	+		+	_
Quinones	sodium hydroxide Test	+	+	+	+
Glycosides	Hydrochloric acid Test	+	+	+	+

Table.5 Mortality of egg *A.dispersus* (*Mundulea sericea* Methanol Bark)

Conc (ppm)	24hrs % Mortality	Mean	Std Deviation	Std error	LC50 (ppm)	LCL-UCL (ppm)	Regression equation	R^2	X^2
Control	0	0.00	0.000	.421	**98.347**	73.066-131.870	Y=2.69+1.35 x	0.971	1.509
25	10.58	2.00	.707						
50	17.31	2.20	.837						
100	25.19	5.80	.447						
200	33.04	6.40	.548						
400	39.70	7.80	.447						

Table.6 Mortality data of *A.dispersus* Adult (Female) *Mundulea sericea* Methanol Bark

Conc (ppm)	24hrs % Mortality	Mean	Std Deviation	Std error	LC50 (ppm)	LCL-UCL (ppm)	Regression equation	R^2	X^2
Control	0	0.00	0.000	.426	**115.655**	85.415-160.772	Y=-2.63+1.28*X	0.976	1.130
25	9.97	1.80	.447						
50	16.11	3.20	.837						
100	23.41	4.80	.837						
200	30.93	5.60	.548						
400	37.68	7.80	.447						

Table.7 Major Compounds of GCMS *Mundulea sericea* leaves

Compound	Area	Area (%)	R-Time	Peak #
BIS 2hydroxy 3-Isobutylrophanate	36434543	59.34	27.465	95
Benzene propionic acid,3,5 bis(Derivative of Isoquercetin)	4180820	6.81	16.546	61
Di butyl phthalate	1531247	2.49	16.818	62
Alpha -amyryin	36	3.25	29.079	99
7,9 –Di-tert-butyl-I-oxaspir(4,5)deca-6,9- dione	4159759	6.77	16.326	59
Hexadecanoicacid,methyl ester	3360451	5.47	16.515	60
I- Nonadecene	593838	0.97	17.151	65
Cis-9-Hexadecenal	572682	0.93	18.749	73
Gamma-sitosterol	480726	0.78	27.988	96
8- Pentadecanone	415097	0.68	15.961	57

Table.8 GCMS of *Mundulea sericea* Bark major compounds

Compound	Area	Area (%)	R.Time	Peak*
15-hydroxy-7oxodehydroabieticacid Methyl	2310002	36.99	29.975	100
Androstan	19470338	31.18	25.498	79
Stigmastrol	2036604	3.26	27.355	87
2,4 Bis 4-Methoxyphenyl2-Propylmethox	1109564	1.78	25.140	78
Dibutylpthalate	2817974	4.51	16.825	42
Gamma -sitosterol	27.863	0.98	612100	90
1,6 -Dimethylphenazine	26.243	0.98	612579	81
Stigmast-1-en-3-one	29.541	0.90	562405	99
2(IH –Phenanthrenone,3,4 4a9,10 10a hexane	26.055	0.98	467160	74
Rotenone	27.229	0.63	394081	86

Figure.2

***Mundulea sericea* leaves**

***Mundulea sericea* bark**

Figure.3 Direct Contact Method Egg, Pupa, Adult *A.dispersus* (Female) and Mortality observed under 40X Stereozoom Microscope, Magnus.

Normal eggs observed

Clusters of eggs

Egg before treatment

Egg after treatment

Nymph before treatment

Nymph after treatment

Adult (Female) before treatment

Adult (Female) after treatment

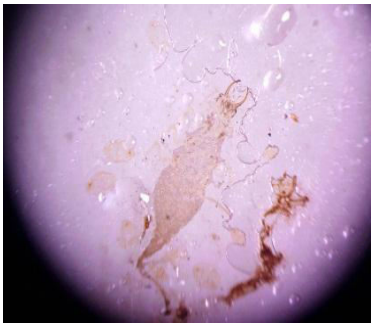


Figure.4

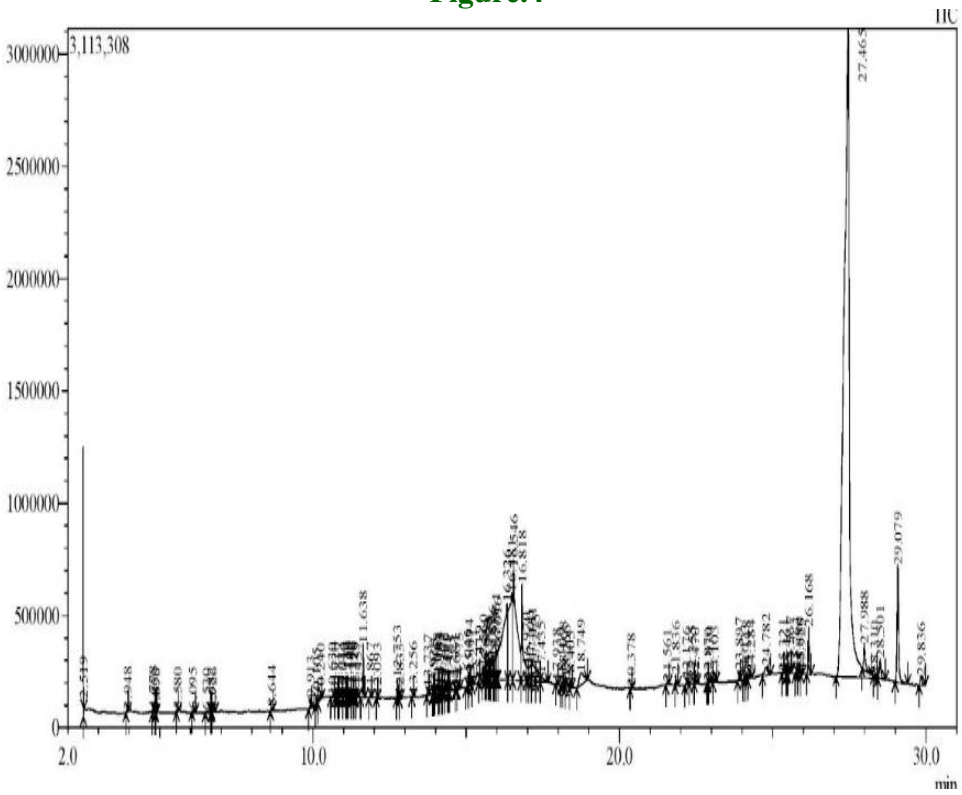
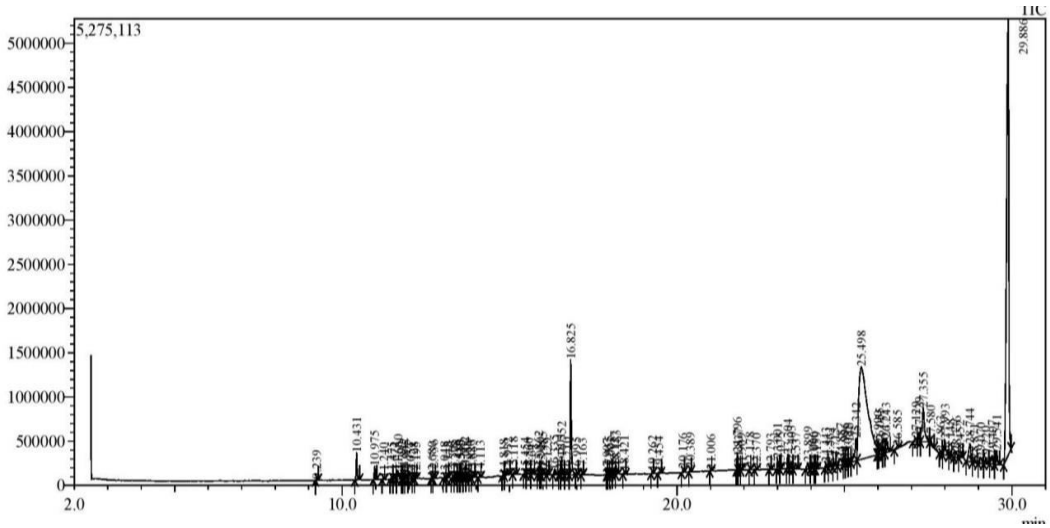


Figure.5 Chromatogram of GCMS- *Mundulea sericea* Bark



This study offers a novel approach for increasing crop output as well as a more effective substitute for controlling insect pest populations (Spiraling whitefly), because therapeutic plants are widely available, using botanical pesticides to control pests is perfect and ideal. Interplay between natural compounds of *Mundulea sericea* leaves and bark extracted resulted in the mortality of *Aleurodicus dispersus*.

Author Contributions

Zakkum Grace Beena: Investigation, formal analysis, writing—original draft. M. Madhavi: Validation, methodology, writing—reviewing. S. Guru Swamy:—Formal analysis, writing—review and editing.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

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