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Research Article

# Insecticidal activities of five plant derived chemicals on *Thrips tabaci* Lindeman

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ABSTRACT: **Background:** Natural compounds originating from plants might be potential alternative pesticide that are not persistent in the environment and are safe to non-target organisms and for use in sustainable agriculture. **Methods:** Ethanolic extracts (30 µl/mL) of *Melia azedarach* L. (Fruits), *Peganum harmala* L. (seeds), *Calendula officinalis* L. (seeds), *Ferula assafoetida* L. (resin) and *Cercis siliquastrum* L. (seeds) were applied against 1–2 and 5–6 days of *Thrips tabaci* Lindeman. All the experiments were conducted by spray test bioassay. Ethanol (95%) was used as a control treatment. **Results:** All the plant derived chemicals were highly toxic against the pre-imago thrips. The mortality percentages of the pest (1–2day old) after 72 hours were more than 66.0% in each of the plant extracts. The highest insecticidal activity against the above-mentioned pre-imago thrips was recorded for the *F. assafoetida* treatment (96.7%). Insecticidal activity was more than 85% in the ethanolic extract *M. azedarach* and *P. harmala* treatments. Moreover, the mortality percentage of the thrips (5–6-day old) after 72 hours was more than 80.6% in the ethanolic extract of *F. assafoetida* treatment. **Conclusions:** The plant derived chemicals tested in this study may be useful as a insecticide in *T. tabaci* management programs, although their safety towards humans needs verification.

KEYWORDS: Melia azedarach, Peganum harmala, Calendula officinalis, Ferula assafoetida, Cercis siliquastrum, Mortality percentage, Thrips tabaci

## INTRODUCTION

*Thrips tabaci* Lindeman (Thysanoptera:Thripidae), commonly known as the onion thrip is a worldwide pest of vegetable crops. It ranges from tropical and subtropical regions into temperate regions. *T. tabaci* is an important pest of field and greenhouse crops all around the world. It causes damages directly by feeding on crop plants, and indirectly by transmitting tomato spotted wilt virus (TSWV), although only the larval stage can transmit this virus.[1] It is difficult to control this pest with insecticides because of its small size and cryptic habits.[2] Morever, *T. tabaci* has been reported to possess a high level of resistance to many insecticides.[3,4] Thus chemical control of these pests have three major disadvantages: pollution of the environment by insecticide residues, development of insect resistance and potential toxicity to non-target organisms.[5] To overcome these problems it is necessary to search for alternative methods of pest control.[6] Plants may provide an alternative to currently used pesticides for the control of plant pests as they constitute a rich source of bioactive chemicals.[7] Recent studies have demonstrated the insecticidal properties of chemicals derived from plants that are active against specific target species, biodegradable to nontoxic products and potentially suitable for use in integrated management programs.[8] Five of plant extracts are extracts of *M. azedarach, P. harmala, C. officinalis, F. assafoetida* and *C. siliquastrum* which have been as the important medicinal plants in Iran. The various studies have conducted on the insecticides activity these plant extracts against other pest. For example, (Nazemi[9] reported that *F. assafoetida* resin

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extract had high repellent activity and insecticidal effect on *Ephestia kuehneilla* and *T. castaneum*. The Fruit extracts of *M. azedarach* a variety of effects in insects, such as insecticidal effect, antifeedant, growth retardation, reduced fecundity, molting disorders, morphogenetic defects, anthelmintic, antiseptic, antipyretic, and repellent activity.[10] The isolated active compounds in extract of *M. azedarach* include such as nimbin, nimbolide, gedunin and azadirachtin.[11] The extracts from *P. harmala* also have insecticidal effect on the different pests such as stored grain pest red flour beetle *T. castaneum*[12] and plant sucking pests including whitefly e.g.: sweet potato whitefly *Bemisia tabaci* Gennadius.[13] The plant-base compounds of *P. harmala* include such as harmane, harmine, harmaline, harmalol, tetrahydroharmine and peganine).[14] In the present study, the toxicity of aqueous extracts of five plants known to have medicinal activity, were investigated against the onion thrips, *T. tabaci*.

## MATERIALS AND METHODS

### Insects rearing

*T. tabaci* was collected from the experimental green house of Shahid Bahonar University of Kerman, Kerman, Iran. The colony was mass reared on bean, plant (Phaseolus vulgaris L) in insect-proof cages (80 × 60 × 60 cm). Uniformaly aged *T. tabaci* individuals were obtained by using round plastic Petri dishes (5.5 cm in diameter) with a meshed hole in the lid to allow air exchange. They were placed on the freshly excised bean leaf discs (4.5 cm diameter) in round plastic Petri dishes filled with a 0.5 cm thick layer of 0.7% agar gel. In each round plastic Petri dish, 30 female *T. tabaci* adults were transferred onto the bean leaf discs for egg laying and removed after 24 hours into insect proof cage. The plastic Petri dishes were kept in climatically controlled growth chamber at 25 ± 1°C temperature and a relative humidity of 60 ± 10% and 16 hours of artificial light at on intensity of about 4000 lux. The relative susceptibility of 1–2 and 5–6 days on *T. tabaci* were used for experiments.

### Plant material and extracts

Five plants known as biochemical were collected from their natural habitats, from different localities of Irans Kerman. They were dried at room temperature under shade conditions for one week until crisp. Then 50 g of each of the dried plants were powdered with an electric stainless steel blender for 5 min and placed in a 500 mL Erlenmeyer flask with 100 mL 95% ethanol for extraction. The mixture was soaked and shaken for 15 min, then was kept in refrigerator at 4°C for 24 hours. The extracts were filtered with Whatman Number 91 filter paper and the extracted substance was tested in different concentrations for each test.

### Bioassay test

In order to determine the effects of the ethanolic extracts fruits of *Melia azedarach*, seeds of *Peganum harmala,* seeds of *Calendula officinalis,* resin of *Ferula assa-foetida* and seeds of *Cercis siliquastrum*, on *T. tabaci*, the relative susceptibility of 1–2, 5–6 days-old individuals of *T. tabaci* was used for biotests. The lower surface leaves was spraying at 30 μl/mL concentration by using a hand-held sprayer (Glass Reagent Sprayer, Kerman Mina Company, Iran). All experiments were carried out under the same laboratory conditions, at 25 ± 1 °C temperature and a relative humidity of 60 ± 10% and 16:8 (L:D) photoperiod. In control treatments, ethanol (95%) was applied. Twelve replicates at 30 μl/mL concentration were used and per replicate were included twenty pests. Mortality was determined after 24, 48, 72 hours from the commencement of exposure. When no leg or antennal movements were observed, insects were considered dead.

### Statistical analysis

The mortality data were adjusted for mortality in the ethanol (95%) using Abbott's correction.[15] The pesticide mortality was calculated as:

$$Ma\% = [(Mt - M)/100 - Mc)] \times 100$$

with Ma = corrected mortality (%), Mt = mortality in treatment (%), and Mc = mortality in the ethanol control (%). For statistical comparison among several means, all the data from the laboratory were subjected to a one-way analysis of variance (ANOVA) followed by a Tukey test (Stat Plus 4.9, 2007).

## RESULTS AND DISCUSSION

The results showed a significant difference in mortality of pre-imago thrips to five plant derived extracts with concentration 30 μl/mL after 1–3 days ($p \leq 0.05$) (Table 1). The mortality percentage on the thrips (1–2-day old) after 72 hours was more than 66% in each of the plant extracts. The highest mortality percentage on thrips (1–2-day old) after 72 hours was caused by the ethanolic extract of *F. assa-foetida* (96.65) ($p \leq 0.05$). While the least insecticidal activity against the thrips (1–2-days old) after 72 hours was recorded in *C. siliquastrum* treatment 66.60%. The mortality percentage of the thrips (5–6-day old) after 72 hours was more than 80.6% in the ethanolic extract of *F. assafoetida* treatment. In all the plant extracts

**Table 1: The mortality percentage of five ethanolic extracts (30 μl/mL) on (1–2 and 5–6 days old) of *Thrips tabaci* after 24, 48 and 72 hours**

| Treatments | Pre-imago Age | Mortality (%) (Mean± SE) after (hours) | | |
|---|---|---|---|---|
| | | 24 | 48 | 72 |
| Calendula officinalis | 1–2 day | 52.34±0.46 Aa | 67.87±0.84 Aa | 68.48±1.77 Aa |
| | 5–6 day | 50.84±1.01 Ab | 59.99±0.08 Bb | 63.63±1.11 Bb |
| Peganum harmala | 1–2 day | 74.58±1.11 Ab | 84.32±0.69 Ab | 85.52±0.49 Ab |
| | 5–6 day | 59.23±1.78 Bb | 69.69±0.87 Bb | 69.69±0.87 Bbc |
| Melia azedarach | 1–2 day | 75.64±1.46 Ab | 84.23±0.82 Ab | 85.52±0.49 Ab |
| | 5–6 day | 58.04±0.60 Bb | 64.84±0.02 Bb | 69.69±0.87 Bbc |
| Cercis siliquastrum | 1–2 day | 47.04±1.29 Aa | 55.87±1.87 Aa | 60.60±1.33 Aa |
| | 5–6 day | 32.86±0.30 Ba | 43.02±0.6 Ba | 47.87±0.90 Ba |
| Ferula assafoetida | 1–2 day | 75.64±1.46 Ab | 80.96±0.82 Ab | 96.65±0.72 Ac |
| | 5–6 day | 54.44±0.07 Bb | 73.33±0.79 Bb | 80.60±0.76 Bc |

Mean in columns followed by different lower case letters indicate significant differences between the different treatments within the same time period and pre-imago age. Mean in colums followed by different upper case letters indicate significant differences between the different pre-imago age within the same treatment and time period at ($p \leq 0.05$) (one- way ANOVA).

the mortality percentage was significantly highest in (1–2-days old) than in (5–6-days old) treatments ($p \leq 0.05$). The mortality of the thrips (1–2 and 5–6 days old) were more than 85% and 69% after 72 hours in *M. azedarach* and *P. harmala* treatments, respectively.

## DISCUSSION

The most important finding of this study is the demonstrated toxicity of different compounds in extracts possessing different bioactivities on this pest. Thus these extracts could be responsible of some features observed in *T. tabaci*. Similar observations on other plant extracts effect on several insects have been reported. For example Jbiluo[12] have reported that *Tribolium castaneum* response varied with plant species. They showed that the adult of *T. castaneum* were more susceptible to extract of *P. harmala* and *Ajuga iva* L. (Laminaceae) than *Raphanus raphanistrum* L. (Brassicaceae). The bioactivity of the harmala plant was shown by Abbassi,[16] who reported that the alkaloides extracted by ethanol from *P. harmala* seeds caused significant mortality of the desert locust, *Schistocerca gregaria* reduced female fecundity, as well as hatching rate when compared to the untreated control. Panji[17] have reported the ethanolic extract from *M. azedarach* fruits had a high insecticidal effect on *Sitophilus oryzae*. Saljoqi[18] have reported that *M. azedarach* extract had a high effect on *Pieris brassicae* mortality percentage Nazemi[19] reported that *F. assafoetida* resin extract had high repellent activity and insecticidal effect on *E. kuehneilla* and *T. castaneum*. Laznik[21] have reported the ethanolic extract from *C. officinalis* had a high insecticidal effect on *Aphis pomi*. The extracts from *P. harmala* also have insecticidal effect on the different pests such as stored grain pest red flour beetle *T. castaneum*[12] and plant sucking pests including whitefly e.g.: sweet potato whitefly *Bemisia tabaci* Gennadius.[13] The finding of our study agree to earlier reports that indicated that most plant extracts have insecticidal properties and can control pests through affecting other biological activities.[20–22] The comparison between the percent total mortality five of ethanolic extracts on *T. tabaci* gives a good vision about theirs bio-activity. The major concept of this study is to show the toxicity of the all the used ethanolic extracts on *T. tabaci*.

## CONCLUSIONS

In conclusion, an attempt has been made to evaluate the role of plant extracts in pesticidal activity. The results reported here open the possibility of further investigations of efficacy on their pesticidal properties of natural product extracts. This naturally occurring plant extract could be useful for pest management of T.tabaci. More studies are needed to bioassay the activity of each identified compound against T. tabaci and other pests.

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