EFFICACY OF POMEGRANATE PEEL AGAINST APHIDS, THRIPS AND SPIDER MITES IN ROSE

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ABSTRACT

Pomegranate (Punica granatum L.) fruit peel (PFPAE) aqueous extract was evaluated for the possible control of common sucking pests of roses viz., aphids (Macrosiphum roseiformis), thrips (Scirtothrips dorsalis) and two-spotted spider mites (Tetranychus urticae). Toxicity bioassays were done with both leaf dip and potted plant treatment and compared with positive control (imidacloprid and spiromesifen). Toxicity bioassays revealed that the mortality was either directly proportional to the concentration or to the exposure time of treatment. At 48 hr exposure time, the mortality at maximum (1x PFPAE) concentration was ranging from ~ 80-90%. Food choice assays indicated that rose leaves treated with PFPAE exhibited high repellent effect on spider mites, thrips and aphids, where the preference was observed to range from 66-80% on control leaves as compared to 5-13% found on the treated leaves at 180 min after exposure.

Key words: Punica granatum, flavonoids, plant extracts, metabolomics, botanical insecticides, behavioural assays, repellency, mortality, leaf dip, potted plants

Rosaceae is the third largest family of plants in both geographical distribution and economic importance behind melon families (Fabales) and grass (Poaceae) (Affeld, 2014). Many insect pests viz., aphids, thrips, spider mites, purring beetles, gram worm, slug worm, castor semilooper etc infest these roses. Their management requires frequent application of pesticides, and many synthetic chemicals are available, which are not ecofriendly. Use of natural and environmentally safe management practices are required for which biopesticides, particularly insecticidal products of plant origin offer good potential. Plant derived biopesticides serve not only to keep away harmful insects (repellents) but some have insecticidal activity also. Clove leaf, lemon, eucalyptus and spearmint extracts exhibit lethal effects on the egg, nymph and adult stages of Trialeurodes vaporariorum Westwood (Choi et al., 2003). Similarly, Adeniyi et al. (2010) observed that Telfaria occidentalis, Sida acuta, Vernonia amygdalina and Ocimum gratissimum are lethal to bean weevils. Dhembar et al. (2011) reported antifeedant property of Annona reticulata, A. squamosa, Azadirachta indica and Allium sativum for rose aphid Macrosiphum rosaeformis Davis. Similarly, leaves and flower extracts of Spilanthes calva and Heliotropium indicum reveal antifeedant effects on Helopeltis theivora Waterhouse (Doliui and Deb Nath, 2010). In an earlier study, citrus peel (Gupta et al., 2017a) and wild pomegranate (daru) peel (Gupta et al., 2017b) and papaya leaf (Gupta et al., 2020) aqueous extracts were shown to exhibit insecticidal and repellent effects against M. rosaeformis. Punica granatum L. (pomegranate) has been used as a traditional medicinal plant and as a dietary supplement; it has antioxidant, medicinal, toxic and anti-inflammatory activities (Yoshimura et al., 2005; Jurenka, 2008; Dipak et al., 2012). Also, it has been shown to possess antimicrobial (Morsy et al., 1998; Gandhi et al., 2010; Mohammad, 2012; Gandhi and Pillai, 2011), acaricidal (Abo-Moch et al., 2010; Al-Yousuf et al., 2010) and insecticidal activities (Mansour et al., 2004; Gandhi and Pillai, 2011; Eldiasty et al., 2014; Farag and Eman, 2016; Gupta et al., 2017b). The present study is in continuation of searching possible use of P. granatum peel (PFPAE) aqueous extract against sucking pest complex of ornamental roses.

MATERIALS AND METHODS

Punica granatum purchased from the local mandi was used, and a catalogue number (8583) with a sample from the same stock sent to the Department of Botany, Panjab University, Chandigarh. Rose aphids (M. roseiformis), thrips (Scirtothrips dorsalis Hood) and two spotted spider mites (Tetranychus urticae Koch) were collected from field and stock cultures maintained in greenhouse on roses. For PFPAE extract preparation to perform bioassays fruits were washed with water
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and alcohol thoroughly and peel was removed. It was air dried for few days which later grounded and saved for further experimentation. 100g of peel powder was mixed with 250ml of water in mixer-grinder slowly for 5 min. This original concentration was labelled x. In addition, two serial dilutions were made to obtain 0.5x and 0.25x, respectively. Shelf life for prepared extract was fixed to be seven days when kept under refrigeration.

For residual bioassays (field bioassays), 64 rose plants (4/ treatment) were treated with four treatments viz. two concentrations of aqueous PFPAE (x and 0.5x), a commercial insecticide ‘imidacloprid’ (Confidor 200SC at labelled rate @ 0.25ml/ l) for thrips and aphids and a miticide ‘spiromesifen’ (Oberon 2SC at labelled rate @ 0.4ml/ l) for spider mites and untreated control. These were sprayed as a foliar spray, and from each plant two leaf samples were collected randomly. Treated and untreated leaflets were collected at 1, 2, 3, 5, and 7 DAT (days after treatment) and brought to the laboratory for bioassays. Leaflets were kept in petridish (90x 15 mm) separately, and ten insects/ mites were released on them. Leaflets collected at different DAT were bioassayed with new insects/ mites. Number of aphids, thrips and spider mites were observed and noted at 24 and 48 hr after the release for each experimental day (1, 2, 3, 5, and 7 DAT) (sample size- n = 300 insect/ mites). Every treatment had three replications with replicates at different dates (n = 3x3). Data obtained were subjected to ANOVA for comparison of means by Tukey’s HSD test; data were analysed for homogeneity using Welch’s tests (JMP, SAS Institute 2005).

RESULTS AND DISCUSSION

Efficacy test performed with aphids by feeding them PFPAE treated rose leaves revealed that at 24 and 48 hr, mortality of aphids was significantly more than untreated control at all three concentrations (x, 0.5x and 0.25x); maximum mortality was obtained at x concentration (92%) at 48 hr (Table 1). Similarly, with thrips efficacy data revealed that all the concentrations were toxic and caused significant mortality; and 50% mortality was obtained at 24, which increased to 73-80% at 48hr (Table 1). Similarly, toxicity with spider mites was significant with mortality 24 and 48 hr, in all the three concentrations. The data from field experiments presented in Fig. 1A-E, reveal that the mortality of aphids when fed with PFPAE (0.5x) was significant only up to 3 DAT at both 24 and 48 hr of observations. However, the PFPAE (x) showed significantly different mortality up to 5 DAT. Similar results were also obtained with thrips (Fig. 2A-E). In case of spider mites,

Table 1. Mortality of aphids, thrips and spider mites with pomegranate fruit peel aqueous extract (PFPAE)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Aphids</th>
<th>Thrips</th>
<th>Spider mites</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>24 hr</td>
<td>48 hr</td>
<td>24 hr</td>
</tr>
<tr>
<td>PFPAE (0.25x)</td>
<td>46.7± 5.3a</td>
<td>45.5± 6.8b</td>
<td>42.2± 7.7a</td>
</tr>
<tr>
<td>PFPAE (0.5x)</td>
<td>50.0± 5.8a</td>
<td>65.5± 7.1b</td>
<td>55.6± 7.3a</td>
</tr>
<tr>
<td>PFPAE (x)</td>
<td>54.4± 5.3a</td>
<td>92.2± 2.2a</td>
<td>57.8± 6.2a</td>
</tr>
<tr>
<td>Control</td>
<td>10.0± 2.5b</td>
<td>16.7± 3.1c</td>
<td>10.0± 3.9b</td>
</tr>
<tr>
<td>F (df), P treatment</td>
<td>22.3 (3,38)</td>
<td>42.5 (3,38)</td>
<td>14.3 (3,38)</td>
</tr>
<tr>
<td>(Welch)</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>F (df), P treatment</td>
<td>31.9 (3,16)</td>
<td>124.3 (3,17,4)</td>
<td>18.9 (3,17,5)</td>
</tr>
<tr>
<td>(Welch)</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

Means in same column followed by different letters significantly different (Tukey-Kramer HSD, α = 0.05)
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PFPAE (x) caused significant mortality up to 7 DAT as compared to control; and at 0.5x gave significant mortality only until 5DAT (Fig. 3A-E). On the other hand, imidacloprid showed significant mortality of all the three pests up to 7 DAT (Figs. 1-3).

The mortality with PFPAE(x) treatment at 48hr with aphids (Fig. 1F) and spider mites (Fig. 2F) at 1 and 2 DAT, and with thrips (Fig. 3F) in 1DAT was varying only insignificantly compared to imidacloprid or spiromesifen. The dual choice assays indicated mortality of aphids with PFPAE extract/ only water treated rose leaf at 30, 90 and 180 min was 6.7- 0% ($\chi^2$ =2.38; NS), 6.7 - 52.0% ($\chi^2$=8.32; p = 0.0039) and 13.2 - 66.7% ($\chi^2$=3.82; p = 0.0507) respectively (Fig. 4A).

With thrips, these values were: 0 - 40% ($\chi^2$ = 1.05; p = 0.0959), 5 - 46.7% ($\chi^2$=4.49; p = 0.0339) and 6.6- 80% ($\chi^2$= 8.32; p = 0.0039), respectively (Fig. 4B); and with spider mites, these were: 0-40% ($\chi^2$ = 1.05; p = 0.0959),

Fig. 1. Mortality of aphids at 24 and 48 hr time intervals when fed with untreated and treated rose leaves- A. one, B. two, C. three, D. five and E. seven days after treatment (DAT). (F) Indicates comparison of mortality in treatments positive control and PFPAE (x) at different days. Means in the same column followed by a common letter not significantly different ($\alpha$ = 0.05, Student’s t LSD Test). Error bars represent standard error of mean.
Fig. 2. Mortality of thrips at 24 and 48 hr time intervals when fed with untreated and treated rose leaves- A. one, B. two, C. three, D. five and E. seven days after treatment (DAT). (F) Indicates comparison of mortality in treatments positive control and PFPAE (x) at different days. Means in the same column followed by a common letter not significantly different (α = 0.05, Student’s t LSD Test). Error bars represent standard error of mean.
Fig. 3. Mortality of spider mites at 24 and 48 hr time intervals when fed with untreated and treated rose leaves- A. one, B. two, C. three, D. five and E. seven days after treatment (DAT), (F) Indicates comparison of positive control and PFPAE (x) at different days. Means in the same column followed by a common letter not significantly different (α = 0.05, Student’s t LSD Test). Error bars represent standard error of mean.
5 - 46.7% (χ² = 4.49; p = 0.0339) and 6.7 - 80% (χ² = 8.32; p = 0.0039), respectively (Fig. 4C).

PFPAE aqueous extracts are thus effective against pests of *Rosa* spp. Leaf dip and residual bioassays proved their toxicity, concluding the high toxicity towards aphids and spider mites at all the concentrations; and only highest concentration against thrips; these at all concentrations cause ~ 50% mortality of all the three pests at 24 hr, with mortality being either directly proportional to the concentration and/or the exposure time. At 48 hr exposure time, the mortality at highest (1x PFPAE) concentration was ranging from ~ 80-90% for these pests. Food choice assays revealed high repellent effect of rose leaves treated with PFPAE on spider mites and thrips as after 180 min of release; and reached almost 80% on the leaf discs which were only water treated as compared to ~ 5% found on treated leaves. In case of aphids this was 66.7% at 180 min after. Results of residual toxicity bioassays against pests proved that PFPAE has insecticidal and acaricidal property and remain effective up to 5 days after treatment at x concentration. The mortality with x concentration at 48hr with aphids and spider mites at 1 and 2 DAT and with thrips in 1DAT varying non-significantly with imidaclorpid/ spiromesifen.

Many earlier reports indicated the insecticidal effects of pomegranate juices of various botanical parts. Ben Hamouda et al. (2014) observed high mortality of *Tribolium castaneum* larvae treated with peel extracts. Mohammadreza et al. (2019) documented its sublethal effects on *T. urticae* with oviposition period, fecundity and growth rate showing significant reduction. Jin-Soun (2015) investigated the ethanol extracts of peel obtained from root, stem and fruit. Ghandi and Pillar (2011) observed the effect of pulverized leaf against stored grains pest *Rhyzopertha dominica* with high mortality and reduced development. Nirjara and Sujatha (2011) also observed such effects of pulverised leaf treated wheat medium. Eldiasty et al. (2014) evaluated pomegranate and apricot extracts against mosquito *Culex pipiens* larvae. Farag and Emam (2016) observed insecticidal activities of pomegranate fruit peels and crude juices of leave on cotton leaf worm *Spodoptera littoralis*. In an earlier study with wild pomegranate (daru) peel insecticidal and repellent effects against *M. rosaeformis* had been demonstrated. It was also observed that this botanical concoction was completely safe for insect predator *Coccinella septumpunctata* (Gupta et al., 2017b). This study chose to use water based extracts of pomegranate peel rather than using organic solvents as to develop botanical insecticide which would be easy and safe to make, ecofriendly and economical to farmers.

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REFERENCES


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Gandhi N, Pillai S, Patel P. 2010. Efficacy of pulverized Punica granatum (Lythraceae) and Murraya koenigii (Rutaceae) leaves against stored grain pests Tribolium castaneum (Coleoptera: Tenebrionidae). International Journal of Agriculture and Biology 12: 616-620.


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