EFFICACY OF DIFFERENT MEDICINAL PLANT EXTRACTS FOR SCIRTOTHRIPS BISPINOSUS MANAGEMENT IN TEA

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ABSTRACT
Medicinal plant extract is used to mitigate, eradicate or cure diseases as it contains bioactive molecules. The aim of the study was to find out the most efficient and auspicious plants which are effective for controlling tea leaf’s thrips (Scirtothrips bispinosus). Five medicinal plants extracts viz. Polygonum hydropiper, Persicaria flaccida, Monochoria hastata, Sapium indicum and Annona reticulata had been used with four different concentrations in this study. One-way ANOVA and Post-hoc test along with coefficient of variation (CV) was used to fulfill the aim of the study. The study found that Persicaria flaccida and Sapium indicum are the most auspicious among all the experimented plants extracts based on both time and concentration. In the study, average mortality was found 3.1 for 1%, 6.9 for 5%, 9.6 for 10% and 11.7 for 15% concentrations, respectively. However, the mortality of thrips increases significantly with the increase of concentrations. Coefficient of variance was found minimum for Sapium indicum (0) and Persicaria flaccida (4.97) plants based also on time and concentration. Ultimately the study concluded that two plants viz. Sapium indicum and Persicaria flaccida are the most effective plants among the five experimented plants for controlling the tea thrips. For the rest of the three plants, the effectiveness could be ranked as Monochoria hastata>Polygonum hydropiper>Annona reticulata, respectively.

Key words: Bioactive, extracts, Post-hoc test, tea, thrips.

Introduction
In world, 1034 species of arthropods, 82 species of nematodes, 1 algal disease and 350 fungal diseases are associated with tea plants (Chen and Chen, 1989). So far 4 mites, 25 insects, 10 nematodes, 18 fungal and 1 algal disease and 37 preponderant weed species have been recorded in tea plantation in Bangladesh (Sana, 1989). Crop loss is, recorded about 10-15% annually, caused by pest attack (Ahmed, 2005; Mamun et al. 2016). Tea plant is exposed to attack of pests, diseases and weeds all over the season (Paul et al., 2017). Scirtothrips bispinosus of Thripidae family commonly known as Bengal tea thrips are tiny, slender and having fringed wings. Tea Thrips are prevalent in Darjeeling during summer months and its serious attacked is noticed during May and June (Bhujel et al., 2016). Scirtothrips bispinosus is responsible for devastating damage at youngest open leaves in tea plants during flashing periods. The sucking marks of thrips made thin pale lines under the leaves parallel to the main vein. As a result, normal leaves are turned into thicker, harder and often puckered as well as deformed (Saha et al., 2010). Overzealous and indiscriminate use of many synthetic pesticides during recent decades in controlling plant pests has resulted in a number of environmental and toxicological problems (Mamun and Ahmed, 2011). Reducing the release of synthetic chemicals into the environment requires the alternative sources of chemicals development that can be used safely in the management of plantation pests. The increasing awareness of negative effects of synthetic pesticide on human and animal health and the agro-ecosystem, research efforts on alternative and more environmentally friendly methods of controlling pests and diseases have proliferated (Zhou et al., 2019; Hagstrum and Athanassiou, 2019). The biological activity of essential oil extracted from the leaves of Polygonum hydropiper and a compound, isolated from this plant was bio assayed against larva of mosquitoes, Anopheles stephensi and Culex quinquefasciatus (Maheswaran and Ignacimuthu, 2013). Some plant extracts possess significant ovipositor difference or antifeedant or toxic
effects on selected tea pests (Hazarika et al., 2008). As many as 2121 plant species have been reported to possess’ pest control properties (Jacobson, 1989). 25 of these plants’ species possess the characteristics required for an ideal botanical insecticide and are therefore more promising for use in organic pest control programs (Radhakrishnan, 2005). These botanical materials can be used as an alternative to chemical pesticides. It will help in controlling major pests of tea such as Helopeltis, Red spidermite, Thrips, Flush worm, Termites, Nematodes etc. Azad et al., (2020) showed that average mortality of tea thrips (Scirtothrips bispinosus) increases significantly with the increase of concentrations.

Chemical pesticides accelerate the rate of genetic resistance in plants. Sometimes insecticides kill natural predators and parasites that may be helpful for controlling the pest of tea population as well as harmful for wildlife. In spite of regular use of insecticides, failures in controlling the pest species observed frequently (Gurusubramanian et al., 2008; Roy et al., 2008). Failure of insecticides occurs due to metabolic detoxification of insecticides (Saha et al., 2010). The major variation observed in showing detoxifying activities of insecticide-treated plantation comparing with organic plantation as well as laboratory-reared pest (Saha et al., 2011). Using chemical pesticide is a burning issue in consideration of made tea export. Extensive uses of chemical pesticide resulting residues which become a major problem for the tea industry. There are also some advantages using chemical pesticides such as improve crop quality and production, faster control of pest and insect. Locally available medicinal plants have strong inhibitory effect against pest, insect and microbes of wheat as an alternative eco-friendly disease management system (Bhardwaj, 2014). The botanical extracts showed more efficacies to control fruit-borer pest of tomato comparing with different insecticides using minimum infestation percentage (Awasthi and Avasthi, 2017). Indigenous medicinal plants are the significant natural sources which are used to control the thrips of tea leaves (Azad et al., 2020). Tea leaves are consumed globally as aromatic beverage as well as health drinks. Using chemical pesticides result in health hazardous residue in made tea, so it creates demand to control tea pest by using plant extract which have almost zero residual effect. Till now no research work has done with a view to control thrips specifically by using medicinal plant extract. Recently thrips become a major pest though it was minor in past decades. Considering the above evidences, the present article is undertaken an approach for measuring the efficiency of medicinal plants extracts to control the tea thrips named Scirtothrips bispinosus naturally.

Materials and Methods

This experimental study was aimed to find out the effectiveness and potentiality of the plant extracts in the mortality of tea thrips for different concentrations of the plant extracts and different time bounds. That is why, thrips affected tea leaves were used as the fundamental units of the study. Habibnagar Tea Estate, Khan Tea Garden (Sylhet district) and Baraoora Tea Estate (Moulvibazar district) located in the North-East of Bangladesh were selected to collect the infected tea leaves as sample. In this study, five medicinal plants viz. Polygonum hydropiper (Marsh pepper), Persicaria flaccid (Lal-bishkatali), Monochoria hastata (Arrow Leaf Pondweed), Sapium indicum (Nalgoti) and Annona reticulata (Bullock’s heart), had been used as the plant extracts. Plant extraction efficiency is influenced by characteristics of phytochemicals, extraction procedure, particle size of chemicals, the solvent used, and the effect of nosy substances (Do et al., 2014). Using semi in vitro method, 5 ml essence of plants was used for each sample. Fruit barks were used in case of Sapium indicum to get the extract. Only leaves are used in case of Annona reticulata, whole plant including leaves were used to get the essence of other 3 plants using 50% alcohol. To extract phenolic compound Ethanol/water solvents are more effective than water as well as ethanol extracts showed a higher antioxidant activity than water extracts (Mello et al., 2010). With a view to obtain optimum result water and alcohol mixture are used to prepare extraction. As polar solvent water is used in the extraction of a wide range of polar compounds (Das et al., 2010). Besides these it is cheap, nontoxic and nonflammable. Alcohol is also polar in nature, easily miscible with water, and extracts polar secondary metabolites in cold condition (Tiwari et al., 2011). The plant parts collected from different locality are dried in sun and grinding to fine powder. Fine powder of dried materials facilitates insecticidal or pesticidal action. Lessening particle size increases surface contact between samples and solvent used to prepare extract. Grinding
resulted in coarse smaller samples; meanwhile, Due to have homogenous and smaller particle powdered samples are more effective than grinding sample which lead to better surface contact with extraction solvents (Azwanida, 2015). This particular pre-preparation is important, as for efficient extraction to occur, the solvent must make contact with the target analytes and particle size smaller than 0.5 mm is ideal for efficient extraction. The laboratory work was carried out at Department of Food Engineering and Tea Technology, Shahjalal University of Science and Technology, Bangladesh at early tea plucking season 2020. The extracts of these five medicinal plants were used to observe and record the mortality of tea thrips in thrips affected tea leaves. A total of twelve thrips were observed to record the death affect in the tea leaves using four different concentrations viz. 1%, 5%, 10% and 15% for each of the five plant extracts. Besides the mortality of thrips, the time to death affect were also observed and recorded for analysis. The whole procedure was repeated or replicated three times for each of the plants. A total of 20 thrips affected tea leaves were collected using five medicinal plant extracts and four solution concentration. Finally, the samples were increased into 60 because of three times repetition of the experiment.

Data analysis was carried out using some descriptive and inferential statistics. Descriptive were used to illustrate the overall results of the study and the coefficient of variation (CV) was used here to rank the plant extracts in the strength of mortality of thrips. Mainly, the study focused on the analysis of variance (ANOVA) and post-hoc test to meet the goal of the study. With the overall significant difference in the average mortality of thrips, the Post-hoc tests were carried out to determine the significantly different pairs of plants extracts for same concentration and same time to death affect.

Results and Discussion

The fundamental results of the study are presented in the following figures. The average mortality of thrips regarding all concentrations was found different from plants to plants (Fig. 1). The extracts from the plant S. indicum was found as most effective (8.92) based on the average mortality of thrips. Previous research work revealed that the fruit of Sapium contain insecticidal, antimicrobial, and pesticidal properties (Rahman and Monowar, 2014). The extract derived from A. reticulata was found as less effective (6.83) than all other plants based on their strength on the average mortality of thrips. Leaf extraction taking from the leaf and stem bark of A. reticulate were used to control pest and insect. Leaf extract of A. reticulata can be used to fabricate silver nanoparticles. Silver nanoparticles have potent insecticidal and bactericidal properties (Malathi et al., 2019). Aqueous extracts of A. reticulata was shown to have potent larvicidal activity without harming the non-target insect and its silver nanoparticles also exhibit antimicrobial activities (Parthiban et al., 2018). The average mortality of thrips was found as 8.58 for P. hydropiper, 7.42 for P. flaccida and 8.00 for M. hastata. Previous study on insecticidal efficiency of P. hydropiper by Kundu et al. (2007) revealed that the extracts of P. hydropiper based on chloroform and ethyl alcohol had remarkable residual effects on T. castaneum by increasing the population mortality. Another research work done by Bhattarjee et al. (2020) on insecticidal efficiency of P. hydropiper showed that methanol and petroleum ether extract of P. hydropiper exhibited excellent toxicity and insecticidal activities. The ranking of the plants was found here as S. indicum, P. hydropiper, M. hastata, P. flaccida and A. reticulata (Fig. 1).

The average mortality of thrips regarding all plants was increases with the increase of solution concentration. The average mortality was found maximum (11.47) at 15% concentration of plant extracts while the minimum mortality (3.80) was found for lowest percentage of concentration (1%) of plant extracts. However, using 5% and 10% of solution concentration, the average mortalities were found as 6.93 and 9.60, respectively. The average mortality of thrips considering all concentration and plants were found different for different time bounds. It was found that a maximum of 9.00 mortalities had been occurred during 24 hours of time and minimum of 3.35 mortalities were occurred up to 6 hours of time bound. On average, 8.20 mortalities were occurred in 12 hours and 5.79 mortalities were occurred in 18 hours of time bound. The effectiveness and potentiality of the plant extract in the same time bound were determined by the minimum required time to death affect along with the ranking of plant extracts (Table 1). However, the
plant extract from *S. indicum* had strength to occur 4.43 mortalities on average within 6 hours and 10.40 mortalities within 12 hours. On average, 2.00 and 9.14 mortalities were occurred within 6 hours and 12 hours respectively using the plant extracts of *P. hydropiper*. Similarly, *P. flaccida* took 6 hours to 18 hours to occur 3.20 to 11.50 mortalities respectively. The extract of *M. hastate* was found effective to occur 2.00 mortalities in 12 hours and also 9.20 mortalities in 24 hours of time bound.

![Fig. 1. Average mortality of thrips by plant extracts](image1)

![Fig. 2. Average mortality of thrips by solution concentration](image2)
Table 1. Death effect of thrips (N=12) based on different time bound for each plant extracts

<table>
<thead>
<tr>
<th>Medicinal Plants</th>
<th>Time bound (in hours) to death affect</th>
<th>6 hours</th>
<th>12 hours</th>
<th>18 hours</th>
<th>24 hours</th>
<th>CV (%)</th>
<th>Ranking</th>
<th>Mean ± SD</th>
<th>Mean ± SD</th>
<th>12 hours</th>
<th>18 hours</th>
<th>24 hours</th>
<th>Mean ± SD</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>CV (%)</td>
<td>Ranking</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>CV (%)</td>
<td>Ranking</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>CV (%)</td>
<td>Ranking</td>
</tr>
<tr>
<td><em>Polygonum hydropiper</em></td>
<td></td>
<td>2.00 ± 1.00ab</td>
<td>9.14 ± 2.27a</td>
<td>24.84</td>
<td>2</td>
<td>0.00 ± 0.00</td>
<td>0.00 ± 0.00</td>
<td></td>
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<tr>
<td><em>Persicaria flaccida</em></td>
<td></td>
<td>3.20 ± 1.79ab</td>
<td>8.40 ± 2.30a</td>
<td>27.38</td>
<td>3</td>
<td>11.50 ± 0.71a</td>
<td>0.00 ± 0.00</td>
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</tr>
<tr>
<td><em>Monochoria hastata</em></td>
<td></td>
<td>0.00 ± 0.00</td>
<td>2.00 ± 1.00b</td>
<td>50.00</td>
<td>4</td>
<td>5.25 ± 1.89b</td>
<td>9.20 ± 3.56ab</td>
<td></td>
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</tr>
<tr>
<td><em>Sapium indicum</em></td>
<td></td>
<td>4.43 ± 2.51ab</td>
<td>10.40 ± 2.19a</td>
<td>21.06</td>
<td>1</td>
<td>0.00 ± 0.00</td>
<td>0.00 ± 0.00</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td><em>Annona reticulata</em></td>
<td></td>
<td>0.00 ± 0.00</td>
<td>0.00 ± 0.00</td>
<td>-</td>
<td>-</td>
<td>4.63 ± 2.83b</td>
<td>8.75 ± 3.95ab</td>
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</tbody>
</table>

Means within a column followed by the same letters are not statistically significantly different, based on Tukey’s Post-hoc (P=0.05) test (for homogeneous variance) or Games-Howell Post-hoc (P=0.05) test (for non-homogeneous variance).

Table 2. Death effect of thrips (N=12) based on different concentration for each plant extracts

<table>
<thead>
<tr>
<th>Medicinal Plants</th>
<th>Concentration of extracts (in %) to death affect</th>
<th>1%</th>
<th>5%</th>
<th>10%</th>
<th>15%</th>
<th>CV (%)</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>CV (%)</td>
<td></td>
</tr>
<tr>
<td><em>Polygonum hydropiper</em></td>
<td></td>
<td>4.67 ± 0.58a</td>
<td>8.33 ± 0.58a</td>
<td>10.00 ± 0.00ac</td>
<td>11.33 ± 0.58ab</td>
<td>5.12</td>
<td>4</td>
</tr>
<tr>
<td><em>Persicaria flaccida</em></td>
<td></td>
<td>3.33 ± 0.58ab</td>
<td>6.33 ± 0.58ab</td>
<td>8.33 ± 0.58b</td>
<td>11.67 ± 0.58ab</td>
<td>4.97</td>
<td>2</td>
</tr>
<tr>
<td><em>Monochoria hastata</em></td>
<td></td>
<td>3.67 ± 0.58ab</td>
<td>7.00 ± 1.00ab</td>
<td>9.67 ± 0.58bc</td>
<td>11.67 ± 0.58ab</td>
<td>4.97</td>
<td>3</td>
</tr>
<tr>
<td><em>Sapium indicum</em></td>
<td></td>
<td>4.33 ± 0.58ab</td>
<td>8.00 ± 1.00a</td>
<td>11.33 ± 0.58a</td>
<td>12.00 ± 0.00ab</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><em>Annona reticulata</em></td>
<td></td>
<td>3.00 ± 0.00b</td>
<td>5.00 ± 1.00b</td>
<td>8.67 ± 0.58bc</td>
<td>10.67 ± 1.16ab</td>
<td>10.87</td>
<td>5</td>
</tr>
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</table>

Means within a column followed by the same letters are not statistically significantly different, based on Tukey’s Post-hoc (P=0.05) test (for homogeneous variance) or Games-Howell Post-hoc (P=0.05) test (for non-homogeneous variance).
The results from the one-way ANOVA and Post-hoc test identifies that there had some significant difference in the average mortality of thrips during 12 hours and 18 hours of time bound but not in 6 hours and 24 hours of time bound. There had significant difference in the average mortalities of M. hastata versus P. hydropiper; M. hastata versus P. flaccida and M. hastata versus S. indicum in 12 hours of time bound. However, the potentiality and the efficacy of plant extracts were ranked as S. indicum, P. hydropiper, P. flaccida, M. hastata and A. reticulata.

The effectiveness and potentiality of the plant extracts were also determined by the higher average mortality of thrips in the same concentration along with the ranking of the plant extracts (Table 2). The results from one-way ANOVA and Post-hoc test reveals that there had significant difference in the average mortality of thrips within the same concentration of plant extracts. Only the extract from S. indicum had strength on the total 12 mortalities of thrips in 15% solution concentration. The average mortalities were ranges from 10.67 to 11.67 for the rest four plant extracts at 15% concentration. At 10% concentration, P. flaccida had minimum average mortality (8.33) and S. indicum had maximum average mortality (11.33). A. reticulata had minimum average mortality (5.00) and P. hydropiper had maximum average mortality (8.33) at 5% concentration. In the minimum solution concentration (1%), P. hydropiper was more effective with maximum average mortality (4.67) which was just ahead of S. indicum (4.33). A. reticulata was least effective among other plant extracts with minimum average mortality of thrips (3.00). There had no significant difference in the average mortality of thrips in the maximum (15%) solution concentration and significant difference on the average mortality of thrips were found at 10% solution concentration. There had significant difference in the average mortality of thrips between P. hydropiper versus P. flaccida; P. flaccida versus S. indicum, and S. indicum versus A. reticulata at 10% solution concentration. In addition, the potentiality and the efficacy of plant extracts were ranked as S. indicium>P. flaccida>M. hastata>P. hydropiper>A. reticulata.

**Conclusion**

This article concluded that effectiveness for mortality of thrips increases significantly with the increase of concentrations for the plants Polygonum hydropiper, Persicaria flaccida, Monochoria hastata, Sapium indicum and Annona reticulata. Sapium indicum (0) and Persicaria flaccida (4.97) was found most effective for controlling tea thrips based on analysis of variance (ANOVA), post-hoc test and coefficient of variation (CV) based on same concentration and same time to death affect and after that Monochoria hastata, Polygonum hydropiper and Annona reticulate was found respectively.

**References**


