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Dipti Dubey
Post-Graduate, Department of Zoology, Vidyasagar College, Salt Lake Campus, Sector-II, Bidhannagar, Kolkata, West Bengal, India

Sagata Mondal
Post-Graduate, Department of Zoology, Vidyasagar College, Salt Lake Campus, Sector-II, Bidhannagar, Kolkata, West Bengal, India

Salil K Gupta
Medicinal Plants Research and Extension Centre, R.K. Mission, Narendrapur, Kolkata, West Bengal, India

Corresponding Author
Sagata Mondal
Post-Graduate Department of Zoology, Vidyasagar College, Salt Lake Campus, Sector-II, Bidhannagar, Kolkata, West Bengal, India

A preliminary laboratory study on bio-efficacy of some essential oils *vis-a-vis* chemical pesticides and botanical on *Petrobia harti* (Ewing) (Acari: Tetranychidae), a serious pest of a weed, *Oxalis corniculata* in (Family: Oxalidaceae) crop field

Dipti Dubey, Sagata Mondal and Salil K Gupta

Abstract
The present study reports the results of a laboratory- based bio- efficacy study conducted on *Petrobia harti* (Ewing) occurring on a weed, *Oxalis corniculata* with application of essential oils as well as botanical and conventional pesticides. The pooled mean percentage of reduction of different treatments may be arranged in the descending order as: T6 (Propargite) >T5 (Neem oil) >T7 (Cypermethrin) >T4 (Peppermint oil) >T3 (Rosemary oil) >T1 (Eucalyptus oil) >T2 (Lemongrass oil). However, the essential oils treated in this experiment had shown good acaricidal property though they were little inferior to both the conventional chemical pesticides like propergite and cypermethrin.

Keywords: *Petrobia harti*, *Oxalis corniculata*, bio- efficacy, chemical pesticides, botanicals

Introduction
Petrobia harti is an important pest of *Oxalis corniculata* which grows abundantly in several crop fields of West Bengal. As many as 50-100 mites of all stages may be found on both surfaces of leaves causing serious chlorosis. In case of severe infestation, the entire leaf may turn out to be yellowish - white and later suffers from withering. Since a serious infestation was noticed in the medicinal plant garden of R.K. Mission, Narendrapur, it was thought desirable to evaluate the bio-efficacy of some essential oils *vis-a-vis* some chemical pesticides and botanicals towards their efficacy causing adult mortality. The present paper is based on the results of that laboratory experiment.

Materials and Methods
This experiment was performed under laboratory condition using leaf-dish technique (Helle and Sabelis, 1985) [4]. The essential oils (supplied by Precious Aromas, through Amazon) which were selected for evaluation were Eucalyptus oil, Lemon grass oil, Rosemary oil, Peppermint oil along with Neem oil and two chemical pesticides, *viz*.Propargite57% EC and Cypermethrin 5% EC. Essential oils were procured from where the other chemical pesticides were commercially available. The essential oils which were used in the concentration of 1 ml in 20 ml water, Neem oil 0.03% concentration, Propargite 10.5 mg/l. and Cypermethrin 0.05% concentration.
The mite, *Petrobia harti* was collected from Narendrapur campus and 10 adult mites were released on each excised leaf kept on wet cotton pad in Petridis (10 cm diameter). Each Petridish accommodated 3 excised leaves and each treatment was replicated thrice. The Pesticide application was made following leaf-dip technique (Helle and Sabelis, 1985) [4]. After getting the excised leaf immersed in Pesticidal solution, it was kept under ceiling fan to get the leaf dried. After the leaf was fully dried, the test mite was released on each excised leaf at the rate of 10 mites per excised leaf. Observations were recorded after 24, 48, 72, 96 and 120 hours for recording mortality data. The mean mortality based on 3 replications was calculated and the data was subjected to statistical analysis, as required.

Results
All the essential oils had proved Acaricides effect like those of Propargite, Cypermethrin and Neem oil, registering various percentages of mortality at different intervals as indicated in Table-1.

- 24 hours at this interval the highest mortality was recorded in T6 (Propargite) and T5 (Neem oil) which were 49.47% and 47.22% respectively and those were significantly superior as compared to other treatments. In case of T7 (Cypermethrin) the mortality was 41.66% and that was higher than other three treatments. T4 (Peppermint oil) and T1 (Eucalyptus oil) were at per registering mortality of 30.70% and 30.65%, respectively and T2 (Lemongrass oil) was the poorest amongst all. No mortality was recorded in case of untreated control.
- 48 hours at this interval the mortality improved in all the treatments. The highest was in T6 (Propargite) 58.18% and T5 (Neem oil) 56.19% both being at per. T7 (Cypermethrin) was the next best registering mortality of 52.36% and was superior to both T1 (Eucalyptus oil), T3 (Rosemary oil), T4 (Peppermint oil), all the latter three were at per. T2 (Lemongrass oil) had shown poorest performance. As usual, no mortality was recorded in case of untreated control.
- 72 hours T7 (Cypermethrin), T5 (Neem oil) and T6 (Propargite) registered mortality of 64.36%, 63.27% and 60.94%, respectively and all were at per. T1 (Eucalyptus oil), T4 (Peppermint oil) and T3 (Rosemary oil) were next best causing mortality of 50.28%, 48.63% and 46.59%, respectively. T2 (Lemongrass oil) was poorest among all, which registered 25.73% mortality. No mortality was recorded in case of control.
- 96 hours Although at previous interval T7 (Cypermethrin), T6 (Propargite) and T5 (Neem oil) were at per but at this interval T6 (Propargite) 74.33% was found better than both T7 (Cypermethrin) 69.05% and T4 (Peppermint oil) 57.26%which two were at per. T4 (Peppermint oil) and T1 (Eucalyptus oil) registered mortality of 57.26% and 54.23%, respectively and no significant difference was there among themselves. As usual T2 (Lemongrass oil) giving mortality of 27.26% was the poorest among all.
- 120 hours as was found at 72 hours interval where T7 (Cypermethrin), T6 (Propargite), T5 (Neem oil) were at per similar observation was recorded at 120 hours interval also where the mortality was 76.33% (T6Propargite), 74.21% (T7 Cypermethrin) and 73.66% (T5 Neem oil). T4 (Peppermint oil) and T3 (Rosemary oil) had no significant difference among themselves registering mortality of 68.18% and 64.55%, respectively. T1 (Eucalyptus oil) recorded mortality of 57.32% and was significantly better than T2 (Lemongrass oil) where the mortality was 30.46%. No mortality was, recorded in case of untreated ones.

Mean mortality (Pooled data of all the intervals) Based on overall mean% mortality, the treatments can be arranged in the following descending order:
T6 (Propargite)>T5 (Neem oil)> T7 (Cypermethrin)> T4 (Peppermint oil)> T3 (Rosemary oil)> T1 (Eucalyptus oil)> T2 (Lemongrass oil).

Table 1: Percentage reduction of *Petrobia harti*, with application of essential oils, botanical oil and two conventional chemical pesticides at different intervals after application.

Treatment	Dose	Initial Population	% reduction of mite at different intervals after treatment					
			24 hours	48 hours	72 hours	96 hours	120 hours	Mean % mortality
T1 (Eucalyptus oil)	1 ml in 20 ml water	10	30.65 (33.57)	41.42 (40.04)	50.28 (45.16)	54.23 (47.40)	57.32 (49.50)	46.78
T2 (Lemongrass oil)	1 ml in 20 ml water	10	18.85 (25.70)	22.33 (28.24)	25.73 (30.41)	27.26 (31.82)	30.46 (33.51)	24.92
T3 (Rosemary oil)	1 ml in 20 ml water	10	38.18 (38.16)	40.05 (38.99)	46.59 (43.00)	51.62 (45.92)	64.55 (33.45)	48.19
T4 (Peppermint oil)	1 ml in 20 ml water	10	30.70 (33.64)	37.91 (35.00)	48.63 (44.23)	57.26 (49.22)	68.18 (55.69)	48.53
T5 (Neem oil)	0.03 %	10	47.22 (43.38)	56.19 (48.54)	63.27 (52.70)	68.75 (55.99)	73.66 (59.09)	61.81
T6 (Propargite)	10.5mg/l.	10	49.47 (44.65)	58.18 (49.70)	60.94 (51.29)	74.33 (59.55)	76.33 (60.95)	65.65
T7 (Cypermethrin)	0.05%	10	41.66 (40.15)	52.36 (46.33)	64.36 (53.65)	69.05 (56.19)	75.21 (60.12)	60.52
Untreated control		10	0	0	0	0	0	0
S,Em± CD (0.05%)		10	1.07 (2.77)	1.82 (4.73)	1.75 (4.53)	1.08 (2.24)	2.06 (5.33)	1.55

Discussion

None of the earlier workers used the essential oils like Eucalyptus oil, Lemongrass oil, Rosemary oil, Peppermint oil for control against this mite. However, some of the other works are as follows:

Mitra *et al.* (2015) [6] while studying bio-efficacy of some plant extracts against *Petrobia harti* reported marigold plant extract was found to be the best giving mean mortality of 70%, followed by Tulsi, ans Nishinda leaf extracts. Gupta and Mondal (2020) used plants extracts like Neem (Azadirachta indica), Nishinda (*Vitex negumdo*), Bhat (*Clerodend, rum viscosum*), Palash (*Butea monosperma*) and Karanja (*Millettia pinnata*) reported that plant extracts were equally good and any one of those may be used for its management.

El Halawany and Dewidar (2017) [1] tested plant essential oils against two spotted spider mite, *Tetranychus urticae* and also on predatory mite *Phytoseiulus persimilis* and *Neoseiulus c*. According to the authors there was no significant difference among the essential oils Lemongrass oil, Rosemary oil and LC_{50} value ranged between 7.09 and 9.63% for *Phytoseius persimilis* and the perspective values were 4.94 to 9.63 for *N. californicus*. The LC_{50} values of Chamomene, Coriander, Rosemary, Spearmint, Lemongrass, Fennel and Marjoram against adult female of *T. urticae* after 24 hour of treatment were respectively 0.63, 0.62, 0.96, 1.3, 2.04, 2.88 and 5.75%.

Farahani *et al.* (2020) [2] in their experiment with essential oils of *Thymus daemensis, Satureja khuzestanica, Saturejaba khtiaric a*against *T. urticae.* The LC_{50} value of *Satureja khuzestanica* extract was the lowest against the both resistant and susceptible population of the mite. According to the authors, this result indicated that the essential oils of all the selected plants, especially *Satureja khuzestanica*, had a good potential to be used in IPM.

Halder *et al.* (2017) [3] in their experiment with Neem oil against an insect pest of vegetable and found that Neem oil was most effective biopesticide. LT50 value was 45.09 h. against *E. dodeca stigma* and 102.03 h. in case of *B. hilaris.*

Mead (2012) tested Lemongrass oil against *T. urtica* and

worked out its chemical constituents of this oil and found that this oil was more toxic against adults of *T. urticae* using spraying method than leaf- dip technique. It caused highest repellency percentage. Pavela & Benelli (2016) [8] and Mwamburi (2022) [7] reviewed the effectiveness of essential oils as pest control agent and reported their performances.

Discussion

The following conclusion can be drawn from the experiment conducted by the authors All the essential oils (Eucalyptus oil, Lemongrass oil, Rosemary oil, and Peppermint oil) used against the mite, *Petrobia harti* proved acaricidal effect causing reasonably good percentage of mortality though the performance was poor as compared to chemical pesticides like propargite and Cypermethrin and Neem oil.

Both the chemical pesticides were found superior to the essential oils as well as Neem oil.

No mortality was recorded in case of control.

Since this was a laboratory - based experiment, it may not be proper to make any recommendation on the basis of this experiment and that can be done only after repeating the experiment at field level.

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