



E-ISSN: 2278-4136

P-ISSN: 2349-8234

[www.phytojournal.com](http://www.phytojournal.com)

JPP 2020; 9(2): 2431-2434

Received: 22-01-2020

Accepted: 26-02-2020

**C Chinniah**

Department of Agricultural  
Entomology, Agricultural  
College and Research Institute  
Tamil Nadu Agricultural  
University, Madurai, Tamil  
Nadu, India

**K Naveena**

Department of Agricultural  
Entomology, Agricultural  
College and Research Institute  
Tamil Nadu Agricultural  
University, Madurai, Tamil  
Nadu, India

**M Shanthi**

Department of Agricultural  
Entomology, Agricultural  
College and Research Institute  
Tamil Nadu Agricultural  
University, Madurai, Tamil  
Nadu, India

**Corresponding Author:****K Naveena**

Department of Agricultural  
Entomology, Agricultural  
College and Research Institute  
Tamil Nadu Agricultural  
University, Madurai, Tamil  
Nadu, India

## Evaluation of certain plant oils for their acaricidal property against Citrus leaf mite, *Panonychus citri* on acid lime

**C Chinniah, K Naveena and M Shanthi**

**Abstract**

The field investigation was carried out to evaluate the acaricidal property of certain plant oils against citrus leaf mite, *P. citri* at Madurai Agricultural College and Research Institute during *Kharif* 2018. Among the plant oils evaluated, neem oil (6.3 No./ leaf, 76.6% reduction), citrus peel oil (7.0 No./ leaf, 74.0% reduction) and citronella oil (7.3 No./ leaf, 72.9% reduction) were proved to be superior with the least mite population and the highest per cent reduction over untreated check coupled with higher fruit yield (9.6, 7.7, 6.9 t/ha) and increased cost benefit ratio (1:3, 1:2.4, 1:2.1), respectively over untreated check.

**Keywords:** Citrus leaf mite, *Panonychus citri*, plant oils, acid lime

**Introduction**

Citrus is commercially grown in the southern regions of Tamil Nadu, India which ranks sixth among the citrus growing countries in the world. The citrus cultivation ranks third in an area next to mango and banana in India. Citrus orchards occupy an area of 10.55 lakh hectares in the country with an annual production of 127.46 lakh tonnes of fruits with the productivity of 9.90 tonnes per hectare [7]. Around 823 species of insects and mite pests are known to devastate citrus crop in various stages. More than 30 per cent of citrus production is lost in India every year due to this menace of 165 species of insect pests and mites. Many of these pests damage the crop at all stages of crop growth [1]. More than 25 numbers of phytophagous mites have been reported to infest citrus in India [8][2]. Losses due to injury by mites are alarming when climatic conditions are more favourable for their multiplication. LeClerc (1965) recorded 2.5% loss in the production of citrus fruits due to the spider mite damage alone in USA. Seven species of phytophagous mites namely spider mites – *Eutetranychus orientalis* (Klein), *P. citri* (McGregor) and hindu mite – *Schizotetranychus hindustanicus* (Hirst) [Family Tetranychidae]; false spider mites – *Brevipalpus phoenicis* (Geijskes) and *B. californicus* (Banks) [Family Tenuipalpidae]; tarsonemid mites – *Polyphagotarsonemus latus* (Banks) [Family Tarsonemidae] and eriophyid mites – *Eriophyes sheldoni* (Ewing) and *Phyllocoptruta oleivora* (Ashmead) [Family Eriophyidae] have been reported as serious pests of citrus from different parts of India [3].

For a long time, control of insect and mite pests could be done through chemical insecticides and acaricides by planters with the aim of realizing quick and higher returns. The indiscriminate use of insecticides caused adverse effects, like resurgence, outbreak of minor pests besides residues in fruits which obviously resulting in increased cost of cultivation. The replacement of chemical molecules which are otherwise costlier with natural pesticides preserves natural enemies and reduces environmental risks [9]. Keeping these points in view, the field experiment was designed for the management of citrus mites in an ecofriendly manner.

**Materials and Methods**

The field experiment to test the acaricidal property of certain common essential oils against citrus leaf mite, *P. citri* was conducted in a farmer's field at Navini patti village of Melur block, Madurai during *Kharif* 2018. The field experiment was laid out in a Randomized block design with three replications per treatment. Each tree was considered as a replication and the mite population was assessed from twenty leaves/ plant drawn at random and the mean population per ten leaves was worked out after each spray. Totally three sprays were applied at 15 days interval and the population of test mite was assessed on 1,3,7 and 14 days after each spray apart from pretreatment count to ensure that the initial population was above the

threshold level. The data on mite population were subjected to square root transformation followed by LSD to group the treatments according to their efficacy. The fruit yield/ tree was recorded as and when harvested and computed in terms of tons/ ha to work out the incremental cost benefit ratio, taking into account the current market price of fruits. All commercial plant oils were purchased from market and the required concentrations were prepared. Teepol was added at 1% to the spray fluid for better stickyness.

## Results and Discussion

The field count on the mean number of mites per leaf recorded after I spray, suggested that the standard check propargite @ 50 EC 2 ml/ lit. recorded minimum number (4.2 No./ leaf) followed by citrus peel oil (6.3 No./ leaf) which was statistically on par with neem oil (6.6 No./ leaf) and citronella oil (6.8 No./ leaf) (Table 1). Almost similar trend was recorded at the second round after spray with reference to mite reduction nevertheless the standard check propargite @ 50 EC 2 ml/ lit. recorded minimum number of mites (4.1 No./ leaf) followed by neem oil (6.4 No./ leaf) which was statistically on par with citrus peel oil (6.9 No./ leaf) and citronella oil (7.2 No./ leaf) (Table 2). The field data on mite population per leaf recorded after III spray, also suggested that the standard check propargite 50 EC @ 2 ml/ lit. recorded minimum number of mites (4.2/ leaf) followed by neem oil

(6.1 No./ leaf) which was statistically on par with citrus peel oil (7.8 No./ leaf) (Table 3). The comparative check propargite 50 EC recorded the highest per cent reduction of mite over untreated check (84.4%) followed by neem oil (76.6%), citrus peel oil (74.0%) and citronella oil (72.9%) respectively. Similarly, this has reflected on the incremental yield and cost benefit ratio also. The increased yield was recorded in case of propargite 50 EC @ 2 ml/ lit. (9.6 t/ha) followed by neem oil @ 3% (7.7 t/ha), citrus peel oil @ 3% (6.9 t/ha) and citronella oil @ 3% (6.4 t/ha). The pungam oil, lemon grass oil, eucalyptus oil, rosemary oil and cashewnut shell liquid @ 3% recorded the moderate to low per cent reduction of 66.6, 64.0, 59.6, 57.7 and 52.2 per cent respectively (Table 4).

Similarly Patil, 2013 evaluated some of the natural products against citrus leaf miner in acid lime which suggested that alternate spray of NSKE (5%) with thiamethoxam (0.0025%) was significantly superior (21.4%) and higher fruit yield (12.33 t/ha with B:C ratio of 1:1.94) as against NSKE 5% (11.48 t/ha with B:C ratio 1: 1.45). Han *et al.*, 2010 studied the fumigant toxicity of ten plant essential oils against acaricide susceptible and resistant population of *Tetranychus urticae* and *Neoseiulus californicus*. The lemon eucalyptus recorded higher toxicity to susceptible *Tetranychus urticae* (LC<sub>50</sub>: 19.3µg/ cm<sup>3</sup>) and *Neoseiulus californicus* (21.4 µg/ cm<sup>3</sup>), respectively.

**Table 1:** Evaluation of certain plant oils against citrus leaf mite, *P. citri* (I-Spray; Season: *Kharif* 2018; Location: Navini patti village; Block: Melur, Madurai district)

Treatments	**No. of mites/ leaf					
	Pre-treatment count	1 DAS	3 DAS	7 DAS	14 DAS	Mean
T <sub>1</sub> – Pungam oil @ 3%	20.2 (4.5)	11.4 (3.4) <sup>cd</sup>	8.7 (2.9) <sup>c</sup>	6.1 (2.5) <sup>bc</sup>	8.3 (2.9) <sup>cd</sup>	8.6 (2.9) <sup>cd</sup>
T <sub>2</sub> – Cashewnut shell liquid @ 3%	19.8 (4.4)	14.6 (3.8) <sup>e</sup>	12.3 (3.5) <sup>d</sup>	10.7 (3.3) <sup>e</sup>	12.5 (3.5) <sup>e</sup>	12.5 (3.5) <sup>f</sup>
T <sub>3</sub> – Citrus peel oil @ 3%	19.8 (4.4)	7.7 (2.8) <sup>a</sup>	5.4 (2.3) <sup>b</sup>	5.1 (2.3) <sup>bc</sup>	7.1 (2.7) <sup>bc</sup>	6.3 (2.5) <sup>b</sup>
T <sub>4</sub> – Citronella oil @ 3%	20.3 (4.5)	8.1 (2.8) <sup>ab</sup>	6.2 (2.5) <sup>b</sup>	5.4 (2.3) <sup>bc</sup>	7.4 (2.7) <sup>bc</sup>	6.8 (2.6) <sup>bc</sup>
T <sub>5</sub> – Lemon grass oil @ 3%	20.2 (4.5)	12.3 (3.5) <sup>de</sup>	9.6 (3.1) <sup>cd</sup>	7.1 (2.7) <sup>cd</sup>	8.9 (3.0) <sup>cd</sup>	9.5 (3.1) <sup>de</sup>
T <sub>6</sub> – Neem oil @ 3%	20.4 (4.5)	9.7 (3.1) <sup>bc</sup>	6.2 (2.5) <sup>b</sup>	4.4 (2.1) <sup>ab</sup>	5.9 (2.4) <sup>ab</sup>	6.6 (2.6) <sup>b</sup>
T <sub>7</sub> – Rosemary oil @ 3%	20 (4.5)	13.9 (3.7) <sup>e</sup>	11.6 (3.4) <sup>d</sup>	8.7 (2.9) <sup>de</sup>	10.6 (3.3) <sup>de</sup>	11.2 (3.3) <sup>ef</sup>
T <sub>8</sub> – Eucalyptus oil @ 3%	20 (4.5)	13.1 (3.6) <sup>de</sup>	10.4 (3.2) <sup>cd</sup>	9.4 (3.1) <sup>de</sup>	9.7 (3.1) <sup>d</sup>	10.7 (3.3) <sup>def</sup>
T <sub>9</sub> – Propargite 50 EC @ 2ml/ lit.	20.7 (4.5)	6.4 (2.5) <sup>a</sup>	2.8 (1.7) <sup>a</sup>	3.1 (1.8) <sup>a</sup>	4.5 (2.1) <sup>a</sup>	4.2 (2.0) <sup>a</sup>
T <sub>10</sub> – Untreated check	20.5 (4.5)	24.3 (4.9) <sup>f</sup>	27.5 (5.2) <sup>e</sup>	30.2 (5.5) <sup>f</sup>	34.1 (5.8) <sup>f</sup>	29.0 (5.4) <sup>g</sup>
SEd	-	0.1591	0.1957	0.2068	0.1794	0.1809
CD (p = 0.05)	NS*	0.3342	0.4111	0.4344	0.3769	0.3801
CV %	-	5.69	7.90	8.96	6.98	7.10

\*NS – Non significant; DAS – Days after spraying, \*\*Each value is the mean of three replications @ 20 leaves/ plant drawn at random

Figures in parentheses are square root transformed values. In a column, mean value denoted by common letter(s) is/are not significantly different by LSD at P=0.05%

**Table 2:** Evaluation of certain plant oils against citrus leaf mite, *P. citri* (II-Spray; Season: *Kharif* 2018; Location: Navini patti village; Block: Melur, Madurai district)

Treatments	**No. of mites/ leaf					
	Pre-treatment count	1 DAS	3 DAS	7 DAS	14 DAS	Mean
T <sub>1</sub> – Pungam oil @ 3%	19.4 (4.4)	11.6 (3.4) <sup>c</sup>	8.5 (2.9) <sup>cd</sup>	6.7 (2.6) <sup>bcd</sup>	9.3 (3.0) <sup>cde</sup>	9.0 (3.0) <sup>cd</sup>
T <sub>2</sub> – Cashewnut shell liquid @ 3%	19.2 (4.4)	14.5 (3.8) <sup>d</sup>	12.3 (3.5) <sup>f</sup>	11.4 (3.4) <sup>f</sup>	13.2 (3.6) <sup>f</sup>	12.9 (3.6) <sup>e</sup>
T <sub>3</sub> – Citrus peel oil @ 3%	19 (4.4)	8.4 (2.9) <sup>b</sup>	6.3 (2.5) <sup>bc</sup>	5.3 (2.3) <sup>bc</sup>	7.5 (2.7) <sup>bc</sup>	6.9 (2.6) <sup>b</sup>
T <sub>4</sub> – Citronella oil @ 3%	19.4 (4.4)	9.2 (3.0) <sup>b</sup>	5.9 (2.4) <sup>b</sup>	5.4 (2.3) <sup>bc</sup>	8.1 (2.8) <sup>bcd</sup>	7.2 (2.7) <sup>bc</sup>
T <sub>5</sub> – Lemon grass oil @ 3%	19.5 (4.4)	12.5 (3.5) <sup>cd</sup>	9.4 (3.1) <sup>de</sup>	7.3 (2.7) <sup>cde</sup>	9.8 (3.1) <sup>de</sup>	9.8 (3.1) <sup>d</sup>
T <sub>6</sub> – Neem oil @ 3%	19 (4.4)	7.3 (2.7) <sup>ab</sup>	6.2 (2.5) <sup>b</sup>	4.8 (2.2) <sup>b</sup>	7.1 (2.7) <sup>b</sup>	6.4 (2.5) <sup>b</sup>
T <sub>7</sub> – Rosemary oil @ 3%	18.9 (4.3)	13.8 (3.7) <sup>cd</sup>	11.2 (3.3) <sup>ef</sup>	9.4 (3.1) <sup>ef</sup>	11.2 (3.3) <sup>ef</sup>	11.4 (3.4) <sup>de</sup>
T <sub>8</sub> – Eucalyptus oil @ 3%	19.2 (4.4)	12.9 (3.6) <sup>cd</sup>	12.3 (3.5) <sup>f</sup>	8.3 (2.9) <sup>de</sup>	10.5 (3.2) <sup>e</sup>	11.0 (3.3) <sup>de</sup>
T <sub>9</sub> – Propargite 50 EC @ 2ml/ lit.	19.5 (4.4)	5.8 (2.4) <sup>a</sup>	2.3 (1.5) <sup>a</sup>	3 (1.7) <sup>a</sup>	5.2 (2.3) <sup>a</sup>	4.1 (2.0) <sup>a</sup>
T <sub>10</sub> – Untreated check	19.5 (4.4)	22.1 (4.7) <sup>e</sup>	26.3 (5.1) <sup>g</sup>	28.4 (5.3) <sup>g</sup>	31.5 (5.6) <sup>g</sup>	27.1 (5.2) <sup>f</sup>
SEd	-	0.1619	0.2011	0.2042	0.1708	0.1797
CD (p = 0.05)	NS*	0.3401	0.4224	0.4290	0.3589	0.3775
CV %	-	5.87	8.12	8.80	6.44	7.01

\*NS – Non significant; DAS – Days after spraying, \*\*Each value is the mean of three replications @ 20 leaves/ plant drawn at random

Figures in parentheses are square root transformed values. In a column, mean value denoted by common letter(s) is/are not significantly different by LSD at P=0.05%

**Table 3:** Evaluation of certain plant oils against citrus leaf mite, *P. citri* (III-Spray; Season: *Kharif* 2018; Location: Navini patti village; Block: Melur, Madurai district)

Treatments	**No. of mites/ leaf					Mean
	Pre-treatment count	1 DAS	3 DAS	7 DAS	14 DAS	
T <sub>1</sub> – Pungam oil @ 3%	17.2 (4.1)	11.2 (3.3) <sup>cde</sup>	8.5 (2.9) <sup>cde</sup>	7.8 (2.8) <sup>cd</sup>	9.5 (3.1) <sup>cde</sup>	9.3 (3.0) <sup>cd</sup>
T <sub>2</sub> – Cashewnut shell liquid @ 3%	16.8 (4.1)	15.2 (3.9) <sup>f</sup>	12.3 (3.5) <sup>f</sup>	11.6 (3.4) <sup>f</sup>	14.2 (3.8) <sup>g</sup>	13.3 (3.7) <sup>f</sup>
T <sub>3</sub> – Citrus peel oil @ 3%	17 (4.1)	9.2 (3.0) <sup>bc</sup>	7.9 (2.8) <sup>cd</sup>	5.7 (2.4) <sup>b</sup>	8.4 (2.9) <sup>bcd</sup>	7.8 (2.8) <sup>bc</sup>
T <sub>4</sub> – Citronella oil @ 3%	17.4 (4.2)	10.4 (3.2) <sup>cd</sup>	7.5 (2.7) <sup>e</sup>	6.3 (2.5) <sup>bc</sup>	7.9 (2.8) <sup>bc</sup>	8.0 (2.8) <sup>c</sup>
T <sub>5</sub> – Lemon grass oil @ 3%	17.1 (4.1)	11.9 (3.4) <sup>de</sup>	9.2 (3.0) <sup>cde</sup>	8.6 (2.9) <sup>de</sup>	10.3 (3.2) <sup>def</sup>	10.0 (2.8) <sup>cde</sup>
T <sub>6</sub> – Neem oil @ 3%	17.5 (4.2)	7.5 (2.7) <sup>b</sup>	5.1 (2.3) <sup>b</sup>	4.8 (2.2) <sup>ab</sup>	6.9 (2.6) <sup>ab</sup>	6.1 (3.2) <sup>b</sup>
T <sub>7</sub> – Rosemary oil @ 3%	16.9 (4.1)	13.1 (3.6) <sup>ef</sup>	10.7 (3.3) <sup>ef</sup>	10.4 (3.2) <sup>ef</sup>	12.5 (3.5) <sup>fg</sup>	11.7 (2.5) <sup>ef</sup>
T <sub>8</sub> – Eucalyptus oil @ 3%	17.4 (4.2)	12.8 (3.6) <sup>ef</sup>	10.3 (3.2) <sup>def</sup>	9.5 (3.1) <sup>def</sup>	11.7 (3.4) <sup>efg</sup>	11.1 (3.4) <sup>def</sup>
T <sub>9</sub> – Propargite 50 EC @ 2ml/ lit.	17.5 (4.2)	5.2 (2.3) <sup>a</sup>	2.4 (1.5) <sup>a</sup>	3.6 (1.9) <sup>a</sup>	5.7 (2.4) <sup>a</sup>	4.2 (2.1) <sup>a</sup>
T <sub>10</sub> – Untreated check	17.5 (4.2)	19.6 (4.4) <sup>g</sup>	22.8 (4.8) <sup>g</sup>	27.3 (5.2) <sup>g</sup>	29.4 (5.4)	24.8 (5.0) <sup>g</sup>
SEd	-	0.1632	0.1984	0.1935	0.1660	0.1765
CD (p = 0.05)	NS*	0.3429	0.4169	0.4064	0.3489	0.3708
CV %	-	5.96	8.11	8.01	6.14	6.82

\*NS – Non significant; DAS – Days after spraying

\*\*Each value is the mean of three replications @ 20 leaves/ plant drawn at random

Figures in parentheses are square root transformed values

In a column, mean value denoted by common letter(s) is/are not significantly different by LSD at P=0.05%

**Table 4:** Evaluation of certain plant oils against citrus leaf mite, *P. citri* (Season: *Kharif* 2018; Location: Navini patti village; Block: Melur, Madurai district)

Treatments	**No. of mites/ leaf				% reduction over untreated check	Yield (t/ha)	Cost benefit ratio
	I Spray	II Spray	III Spray	Cumulative Mean			
T <sub>1</sub> – Pungam oil @ 3%	8.6 (2.9) <sup>cd</sup>	9.0 (3.0) <sup>cd</sup>	9.3 (3.0) <sup>cd</sup>	9.0 (3.0) <sup>cd</sup>	66.6	6.1 (0.8) <sup>abcd</sup>	1: 1.9
T <sub>2</sub> – Cashewnut shell liquid @ 3%	12.5 (3.5) <sup>f</sup>	12.9 (3.6) <sup>e</sup>	13.3 (3.7) <sup>f</sup>	12.9 (3.6) <sup>f</sup>	52.2	4.0 (0.6) <sup>ef</sup>	1: 1.2
T <sub>3</sub> – Citrus peel oil @ 3%	6.3 (2.5) <sup>b</sup>	6.9 (2.6) <sup>b</sup>	7.8 (2.8) <sup>bc</sup>	7.0 (2.6) <sup>bc</sup>	74.0	6.9 (0.8) <sup>abc</sup>	1: 2.1
T <sub>4</sub> – Citronella oil @ 3%	6.8 (2.6) <sup>bc</sup>	7.2 (2.7) <sup>bc</sup>	8.0 (2.8) <sup>c</sup>	7.3 (2.7) <sup>bc</sup>	72.9	6.4 (0.8) <sup>abcd</sup>	1: 2
T <sub>5</sub> – Lemon grass oil @ 3%	9.5 (3.1) <sup>de</sup>	9.8 (3.1) <sup>d</sup>	10.0 (2.8) <sup>cde</sup>	9.7 (3.1) <sup>de</sup>	64.0	5.1 (0.7) <sup>bcd</sup>	1: 1.5
T <sub>6</sub> – Neem oil @ 3%	6.6 (2.6) <sup>b</sup>	6.4 (2.5) <sup>b</sup>	6.1 (3.2) <sup>b</sup>	6.3 (2.5) <sup>b</sup>	76.6	7.7 (0.9) <sup>ab</sup>	1: 2.4
T <sub>7</sub> – Rosemary oil @ 3%	11.2 (3.3) <sup>ef</sup>	11.4 (3.4) <sup>de</sup>	11.7 (2.5) <sup>ef</sup>	11.4 (3.4) <sup>ef</sup>	57.7	4.8 (0.7) <sup>cde</sup>	1: 1.5
T <sub>8</sub> – Eucalyptus oil @ 3%	10.7 (3.3) <sup>def</sup>	11.0 (3.3) <sup>de</sup>	11.1 (3.4) <sup>def</sup>	10.9 (3.3) <sup>def</sup>	59.6	4.2 (0.6) <sup>def</sup>	1: 1.3
T <sub>9</sub> – Propargite 50 EC @ 2ml/ lit.	4.2 (2.0) <sup>a</sup>	4.1 (2.0) <sup>a</sup>	4.2 (2.1) <sup>a</sup>	4.2 (2.0) <sup>a</sup>	84.4	9.6 (1.0) <sup>a</sup>	1: 3
T <sub>10</sub> – Untreated check	29.0 (5.4) <sup>g</sup>	27.1 (5.2) <sup>f</sup>	24.8 (5.0) <sup>g</sup>	27.0 (5.2) <sup>g</sup>	-	3.2 (0.5) <sup>f</sup>	-
SEd	0.1809	0.1797	0.1765	0.1789	-	0.0964	-
CD (p = 0.05)	0.3801	0.3775	0.3708	0.3758	-	0.2026	-
CV %	7.10	7.01	6.82	6.97	-	16.16	-

\*NS – Non significant; DAS – Days after spraying

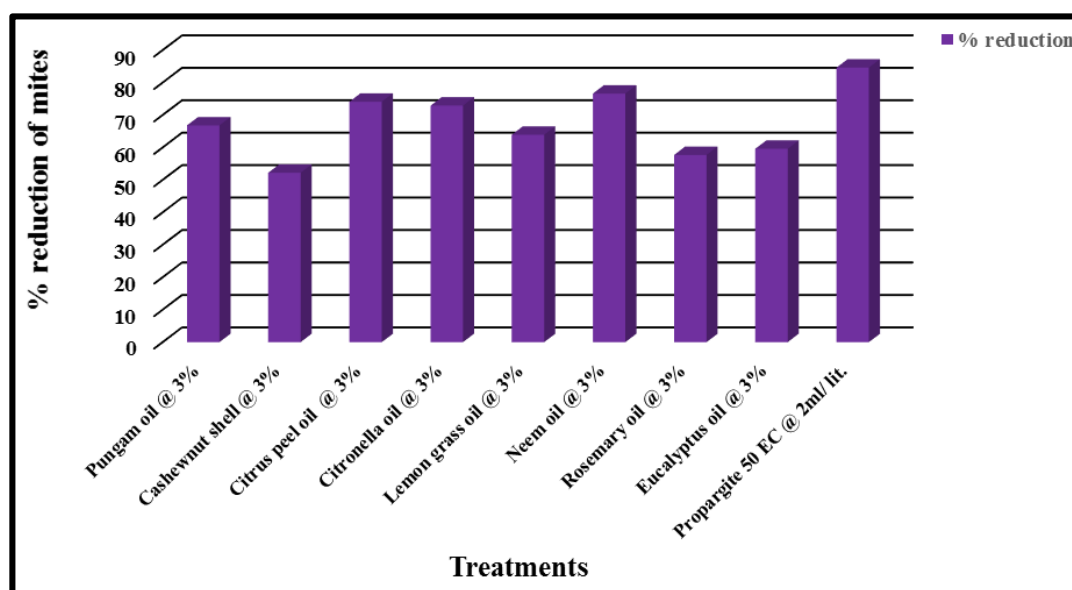
\*\*Each value is the mean of three replications @ 20 leaves/ plant drawn at random

Figures in parentheses are square root transformed values

For yield data log transformation is adapted

In a column, mean value denoted by common letter(s) is/are not significantly different by LSD at P=0.05%

The current market rate of Rs. 30/ kg is considered to work out the CBR

**Fig 1:** Evaluation of certain plant oils against citrus leaf mite, *P. citri*

Shareef *et al.*, 2016 evaluated the effect of leaf extracts of neem (*Azadirachta indica* A. Juss), datura (*Datura stramonium* L.) and peel extracts of lime (*Citrus aurantifolia* Swingle) and kurtuma (*Citrullus colocynthis* L.) at 10, 20 and 30 per cent concentrations against citrus leaf miner, *Phyllocnistis citrella* stainton. The results of their study revealed that peak infestation of leaf miner was appeared in end August to early October, and moreover, foliar application of 30 per cent neem and kurtuma leaf extracts gave up to 12 per cent reduction in the population infestation of citrus leaf miner at 72 hrs post application. Thus, neem extract was recommended to control citrus leaf miner infestation on citrus nursery seedlings.

of Entomology and Zoology Studies. 2016; 4(4):1335-1340.

### Conclusion

Among the very common plant oils evaluated for their toxicity in field conditions against citrus mite *P. citri* revealed neem oil, citrus peel oil and citronella oil @ 3 percent are found promising, occupying the top three ranks with the highest per cent reduction of mites *viz.*, 76.6, 74.0 and 72.9 respectively. This has reflected on increased fruit yield and CBR. Thus the plant oils are very effective against citrus mite besides being cheaper and safer to the environment at recommended doses. This may be promoted in future as ecofriendly strategy, which ofcourse warrants further indepth studies to understand the exact active principle and mode of action.

### References

1. Butani DK. Insect pests of citrus and their control. Pesticides. 1979; 13(4):27-33.
2. Dhooria MS, Gupta SK. Observation on phytophagous and predaceous mites found on citrus from Punjab State. Abstract No. 2066. In National Seminar on Entomology in 21<sup>st</sup> century, held at Udaipur, during April 30-May 2, 1998.
3. Dhooria MS, Bhullar MB, Mallik B. Mite pests of citrus and their management in India. AINP (Agricultural Acarology), UAS, Bangalore, 2005, 28.
4. Han J, Choi BR, Lee SG, Kim SI, Ahn YJ. Toxicity of Plant Essential Oils to Acaricide-Susceptible and -Resistant *Tetranychus urticae* (Acari: Tetranychidae) and *Neoseiulus californicus* (Acari: Phytoseiidae). Journal of Economic Entomology. 2010; 103(4):1293-1298.
5. Leclerg EL. Losses in Agriculture. U.S. Dept. Agr., A.R.S. Handbook. 1965; 291:120.
6. Patil SK. Evaluation of insecticides and natural products against citrus leaf miner in acid lime. Annals of Plant Protection Sciences. 2013; 21(1):30-32.
7. Poovizhiraja B, Chinniah C, Murugan M, Irulandi S, Aiyathan KEA, Balamohan TN. Impact of weather parameters on the population dynamics of major sucking pests of acid lime, *Citrus aurantifolia* Swingle. Journal of Entomology and Zoology Studies. 2019; 7(3):197-201.
8. Prasad V. A catalogue of mites of India. Indira Acarology Publishing House, Ludhiana (Punjab) India, 1974, 320.
9. Rao AR, Rao PK, Jyotsna KP. Efficacy of certain natural insecticides against Citrus leaf miner, *Phyllocnistis citrella* Stainton as prophylactic and curative measures on *Sathgudi* Sweet Orange. Pest Management in Horticultural Ecosystems. 2015; 21(1):11-15.
10. Shareef MF, Raza ABM, Majeed MZ, Ahmed KS, Raza W, Hussain HF. Effect of botanicals on the infestation of citrus leaf miner, *Phyllocnistis citrella* stainton. Journal