



## EVALUATION OF BOTANICALS AGAINST JASSID *EMPOASCA KERRI* PRUTHI IN GROUNDNUT

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### ABSTRACT

Field experiments were conducted during *Kharif* 2017-2018 at Aruppukottai block and Narikudi block, Virudhunagar district, Tamil Nadu, India to evaluate the efficacy of various botanicals against jassid, *Empoasca kerri* Pruthi (Hemiptera: Cicadellidae) on groundnut under rain-fed conditions. Among them, neem seed kernel extract (NSKE) @5% was found to effective against *E. kerri* in both locations [Aruppukottai (65.45%) and Narikudi (64.98%)] than untreated control. Similarly, neem oil @ 3% was also found to effective against *E. kerri* in both Aruppukottai (55.27%) and Narikudi (56.46%). In terms of yield, the highest yield (1523 and 1512 kg/ha) was recorded in the treatment NSKE @ 5% of concentration over the untreated control (910 and 927 kg/ha).

**Key words:** Groundnut, *Empoasca kerri*, botanicals, neem oil, karanj oil, NSKE, chlorpyrifos, yield, economics, cost benefit, Aruppukottai, Narikudi

Groundnut is a principal oilseed crop is grown in India, with major growing states being Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra, and in Tamil Nadu, it is grown in an area of 0.34 million ha (Anonymous, 2018). The actual yield of farmers field are quite low because of insect pests and diseases. More than 350 species of insect pests damage the groundnut (Stalker et al., 1983). Jassid, *Empoasca kerri* Pruthi (Hemiptera: Cicadellidae) causes considerable damage to the groundnut in South India (Amin, 1983), and causes 40.5% pod yield loss (Senguttuvan et al., 1999). Indiscriminate and regular use of broad-spectrum insecticides against such pests cause undesirable problems like development of resistance, pest resurgence and secondary pest outbreak. Hence, cost effective, ecofriendly and safe pest control strategies are required. The present study evaluates the efficiency of the various botanicals against *E. kerri* in groundnut.

### MATERIALS AND METHODS

The field experiment was conducted at Aruppukottai

and Narikudi, Virudhunagar, Tamil Nadu, India during *Kharif* 2017 and 2018. Treatments were applied to 3 replicates arranged in a Randomized Block Design (RBD). Application was made when the leafhopper crossed ETL level (15-20 /plant). The first spray was made at the vegetative stage of groundnut. The second spray was made 15 days after the first application. Both sprays were made on the same plants. Five plants were selected randomly from each plot and the leafhopper population was observed. The pre-treatment count was made at 24 hr before each application and post-treatment observations were at 3, 5, and 10 days after each spray (DAS). The treatment include: *Acorus calamus* @ 2%, neem oil @ 3%, karanji oil @ 3%, *Calotropis gigantea* @ 5%, *Nerium indicum*@ 5%, *Azadirachta indica* @ 5%, *Vitex negundo* @ 5%, Neem Seed Kernal Extract (NSKE) @ 5% and chlorpyrifos 20% EC @2.5 ml/l.

Spraying was taken up during early morning using high volume knapsack sprayer (manufacturer: ASPEE India, Mumbai, Maharashtra, and model: SRP/50) with hallow cone nozzle. The nymph and adult population were subjected to  $\sqrt{x+0.5}$  transformation and analysis for

two fields (Aruppukottai and Narikudi) was carried out (Gomez and Gomez, 1984). The pod yield was recorded from each plot, replication wise and treatment wise, and the same was weighed and subjected for statistical analysis. The mean yield was computed in terms of tonnes/ha and the increase in pod yield in the treated plot over the untreated control was worked out (Bebitha, 2009). Finally, the cost-benefit ratio was also computed using the following formula-

$$\text{Yield increase over control} = \frac{(\text{Yield in treated plot} - \text{Yield in untreated plot})}{\text{Yield in untreated plot}} \times 100$$

## RESULTS AND DISCUSSION

Results obtained from the field experiment conducted to evaluate the effect of different botanicals against jassid are presented in Table 1. The average jassid population ranged from 17.9 to 18.20/plants. These were found to be statistically non-significant, thereby the jassid population was uniformly distributed before the application of botanicals. The results revealed that the first spray with NSKE @ 5% were found to be the most effective (6.83/plant) than other treatments. The next better treatment was neem oil @ 3% (9.37/plant). The results further revealed that the second spray with NSKE @ 5% was consistently most effective (7.83/plant) as compared to other treatments. Similarly, the next best treatment was neem oil @ 3% (9.76/plant) followed by karanji oil @ 3% (10.77/plant) and *Vitex negundo* @ 5% (10.57/plant). However, *Acorus calamus* @ 2% (11.56/plant), and *Nerium indicum* @ 5% (11.78/plant) were found to be less effective.

NSKE @ 5% was consistently the most effective botanical (6.97/plant) compared to other botanicals during third spray. It showed prolonged residual efficacy compared to other botanicals. The next better treatment was neem oil @ 3% (9.02/plant), followed by karanji oil @ 3% (8.93/plant), *Vitex negundo* @ 5% (9.30/plant), *Acorus calamus* @ 2% (9.93/plant) and *Nerium indicum* @ 5% (10.00/plant). The pooled data on the overall efficacy of various botanicals against *E. kerri* revealed that application of NSKE @ 5% (65.45%), neem oil @ 3% (55.27) and karanji oil @ 3% (53.88%) were found to be more effective in controlling the *E. kerri* in groundnut. The lowest reduction over control was found in neem leaf extract 5% (43.25%).

Similar results were obtained at experiment 2 conducted at Narikudi, Virudhunagar, Tamil Nadu, India (Table 2). The average population of jassids ranged from 17.18 to 19/plant. The pooled data of

overall efficacy of various botanicals against *E. kerri* observed that application of NSKE @ 5% had the lowest jassid population (7.28/plant) followed by neem oil @ 3% (9.05/plant) and pungam oil @ 3% (9.29/plant). The highest reduction over control due to the application of NSKE @ 5% (64.98%) neem oil @ 3% (56.46%) and karanji oil @ 3% (55.52%) were found to be most effective botanicals in controlling the *E. kerri*. However, the lowest reduction over control was recorded in neem leaf extract 5% (43.21%). The present investigation is in accordance with the report of Krishna Natak et al. (2017) who reported that NSKE 5% had significantly reduced the jassid population. Similarly, (Rajamanikam et al., 1997; Srinivasalu et al., 1999; Bharathi et al., 2005) observed that application of NSKE 5% was found to be more effective against *E. Kerri*. Earlier, Srinivasalu et al. (1999) reported that application of neem oil 3% was the most effective against jassid than commercial neem formulation. Sathapathi and Ghatak (1990) observed that karanji oil was effective against *Plutella xylostella* (L.) in cabbage. Saradamma (1989) reported that acetone extracts of *Vitex negundo* (2%) resulted in 100% mortality of *Spodoptera litura* (F.) in groundnut.

The yield from treated plots is shown in Table 3. The yield was significantly higher in treated plots, chlorpyrifos gave the highest yield of 1655 kg/ha, and among natural product treatments, neem seed kernel extract was superior (1523 kg/ha). Neem oil treated plots gave 1390 kg/ha, which was similar to karanji treated plots (1355 kg/ha). *Calotropis gigantea* @ 5% and *Azadirachta indica* @ 5% leaf extract, gave a lower yield of 1146 and 1077 kg/ha, respectively. Similar results were obtained at experiment II (Table 4). The yield was significantly higher in treated plots. Chlorpyrifos treated plots gave the highest yield of 1615 kg/ha, and among natural product treatments, Neem seed kernel extract treated plots was the best with yield of 1503 kg/ha; neem oil treated plots gave 1141 kg/ha, which was similar to karanji treated plots (1090 kg/ha). The plots with the treatments of *Calotropis gigantea* @ 5% and *Azadirachta indica* @ 5% leaf extract, gave a lower yield of 1146 and 1077 kg/ha, respectively. The treatment of NSKE 5% (1614 wet pods/ha), neem oil 3% (1608 kg wet pods/ha) and karanji oil 3% (1589 wet pods/kg) were best in groundnut (Arunkumar, 2012).

## REFERENCES

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Table 1. Efficacy of botanicals on *E. kerri* on groundnut (Aruppukottai Block, Virudthunagar)

Treatments	PTC	Population/plant												% reduction over control
		1 <sup>st</sup> SPRAY			2 <sup>nd</sup> SPRAY			3 <sup>rd</sup> SPRAY			MEAN	Pooled data		
IDAS	3DAS	10DAS	MEAN	IDAS	3DAS	10DAS	MEAN	IDAS	3DAS	10DAS			MEAN	MEAN
<i>Calotropis gigantean</i> @ 5%	18.0	14.3 (3.78) <sup>e</sup>	11.7 (3.42) <sup>f</sup>	7.2 (2.68) <sup>g</sup>	11.07 (3.22) <sup>d</sup>	16 (4.00) <sup>d</sup>	12 (3.46) <sup>g</sup>	10 (3.16) <sup>g</sup>	13 (3.61) <sup>f</sup>	10.3 (3.21) <sup>e</sup>	7.2 (2.68) <sup>f</sup>	10.17 (3.19) <sup>e</sup>	11.30 (3.36) <sup>f</sup>	43.96
<i>Acorus calamus</i> @ 2%	18.2	13.54 (3.68) <sup>d</sup>	10.3 (3.21) <sup>d</sup>	5.9 (2.43) <sup>e</sup>	9.91 (3.51) <sup>e</sup>	13.79 (3.71) <sup>e</sup>	11.5 (3.39) <sup>f</sup>	9.4 (3.07) <sup>f</sup>	11.9 (3.45) <sup>de</sup>	10.1 (3.18) <sup>de</sup>	7.8 (2.79) <sup>g</sup>	9.93 (3.15) <sup>e</sup>	10.47 (3.24) <sup>ef</sup>	48.07
<i>Nerium indicum</i> @ 5%	18.3	13.69 (3.70) <sup>d</sup>	11.3 (3.36) <sup>ef</sup>	7.2 (2.68) <sup>g</sup>	10.73 (3.28) <sup>de</sup>	14.2 (3.77) <sup>e</sup>	11.9 (3.45) <sup>g</sup>	9.24 (3.04) <sup>f</sup>	12.1 (3.48) <sup>e</sup>	11.4 (3.38) <sup>g</sup>	6.5 (2.55) <sup>e</sup>	10.00 (3.16) <sup>e</sup>	10.84 (3.29) <sup>ef</sup>	46.26
<i>Vitex negundo</i> @ 5%	17.9	13.56 (3.68) <sup>d</sup>	10.8 (3.29) <sup>de</sup>	6.4 (2.53) <sup>f</sup>	10.25 (3.20) <sup>de</sup>	13.7 (3.70) <sup>e</sup>	9.7 (3.11) <sup>d</sup>	8.3 (2.88) <sup>e</sup>	10.57 (3.25) <sup>cd</sup>	9.8 (3.13) <sup>d</sup>	5.8 (2.41) <sup>d</sup>	9.30 (3.05) <sup>e</sup>	10.04 (3.17) <sup>de</sup>	50.21
<i>Azadirachta indica</i> @ 5%	18.0	13.78 (3.71) <sup>de</sup>	11.4 (3.38) <sup>f</sup>	7.2 (2.68) <sup>g</sup>	10.79 (3.29) <sup>de</sup>	16.2 (4.02) <sup>d</sup>	12.3 (3.51) <sup>g</sup>	10.11 (3.18) <sup>g</sup>	13.4 (3.66) <sup>f</sup>	11 (3.32) <sup>f</sup>	7.6 (2.76) <sup>g</sup>	10.67 (3.27) <sup>e</sup>	11.44 (3.38) <sup>f</sup>	43.25
NSKE@5%	18.1	11.5 (3.39) <sup>b</sup>	5.9 (2.43) <sup>b</sup>	3.1 (1.76) <sup>b</sup>	6.83 (2.61) <sup>ab</sup>	12 (3.46) <sup>b</sup>	7.3 (2.70) <sup>b</sup>	4.2 (2.05) <sup>b</sup>	9.2 (3.03) <sup>b</sup>	6.3 (2.51) <sup>b</sup>	3.2 (1.79) <sup>b</sup>	6.23 (2.50) <sup>ab</sup>	6.97 (2.64) <sup>b</sup>	65.45
Neem oil @ 3%	17.9	12.6 (3.55) <sup>e</sup>	10.3 (3.21) <sup>d</sup>	5.2 (2.28) <sup>d</sup>	9.37 (3.06) <sup>bcd</sup>	13.5 (3.67) <sup>e</sup>	9.2 (3.30) <sup>c</sup>	6.57 (2.56) <sup>c</sup>	10.5 (3.24) <sup>e</sup>	8.7 (2.95) <sup>e</sup>	4.6 (2.14) <sup>e</sup>	7.93 (2.82) <sup>bc</sup>	9.02 (3.00) <sup>e</sup>	55.27
Karanj oil @ 3%	17.5	13 (3.61) <sup>e</sup>	7.9 (2.81) <sup>e</sup>	3.7 (1.92) <sup>e</sup>	8.20 (2.86) <sup>bc</sup>	14.2 (3.77) <sup>e</sup>	10.8 (3.29) <sup>e</sup>	7.3 (2.70) <sup>d</sup>	11.5 (3.39) <sup>d</sup>	8.5 (2.92) <sup>e</sup>	6.8 (2.61) <sup>e</sup>	8.93 (2.99) <sup>e</sup>	9.30 (3.05) <sup>cd</sup>	53.88
Imidachoprid 0.0036%	18.0	9 (3.00) <sup>b</sup>	4.2 (2.05) <sup>b</sup>	2 (1.41) <sup>b</sup>	5.07 (2.25) <sup>b</sup>	8 (2.83) <sup>b</sup>	4.4 (2.10) <sup>b</sup>	2.9 (1.70) <sup>b</sup>	7 (2.65) <sup>b</sup>	4.6 (2.14) <sup>b</sup>	1.2 (1.10) <sup>b</sup>	4.27 (2.07) <sup>b</sup>	4.81 (2.19) <sup>b</sup>	76.14
Untreated control	18.1	20.57 (4.54) <sup>f</sup>	21.6 (4.65) <sup>g</sup>	23.4 (4.84) <sup>h</sup>	21.86 (4.68) <sup>e</sup>	17.4 (4.17) <sup>e</sup>	19.9 (4.46) <sup>h</sup>	22 (4.69) <sup>h</sup>	15.9 (3.99) <sup>g</sup>	19 (4.36) <sup>h</sup>	21.7 (4.66) <sup>h</sup>	18.87 (4.34) <sup>h</sup>	20.16 (4.49) <sup>g</sup>	-
SEd	NS	0.03	0.04	0.02	0.24	0.05	0.04	0.02	0.03	0.03	0.03	0.25	0.08	-
CD 5%	NS	0.07	0.08	0.04	0.51	0.10	0.08	0.05	0.06	0.06	0.06	0.52	0.17	-

DAS: Days after spraying, PTC: Pre-treatment count. \*Grand mean formed by making average values of 3rd, 5th and 10th days after treatment through the means of three replications of three rounds of spray. Figures in parentheses square root transformed values. In a column, means followed by common letter not significantly different by LSD (p=0.05)

Table 2. Efficacy of botanicals on *E. kerri* on groundnut (Narikudi Block, Virudthunagar)

Population/plant Treatments	PTC	1 <sup>st</sup> SPRAY			2 <sup>nd</sup> SPRAY			3 <sup>rd</sup> SPRAY			MEAN	Pooled data	%reduction over control	
		IDAS	3DAS	10DAS	MEAN	IDAS	3DAS	10DAS	MEAN	IDAS				3DAS
<i>Calotropis gigantean</i> @ 5%	19	15.30 (3.91) <sup>f</sup>	12.1 (3.48) <sup>f</sup>	7.80 (2.79) <sup>b</sup>	11.73 (3.43) <sup>e</sup>	16.77 (4.10) <sup>e</sup>	11.5 (3.39) <sup>gh</sup>	12.62 (3.55) <sup>d</sup>	12.5 (3.54) <sup>f</sup>	10.11 (3.18) <sup>d</sup>	7 (2.65) <sup>d</sup>	9.87 (3.14) <sup>de</sup>	11.41 (3.38) <sup>fg</sup>	45.12
<i>Acorus calamus</i> @ 2%	18.5	14.23 (3.77) <sup>d</sup>	10.92 (3.30) <sup>d</sup>	6.00 (2.45) <sup>e</sup>	10.38 (3.22) <sup>bc</sup>	14.33 (3.79) <sup>cd</sup>	11.00 (3.32) <sup>d</sup>	11.44 (3.38) <sup>cd</sup>	11.4 (3.38) <sup>e</sup>	10 (3.16) <sup>d</sup>	7.2 (2.68) <sup>d</sup>	9.53 (3.09) <sup>de</sup>	10.45 (3.23) <sup>ef</sup>	49.72
<i>Nerium indicum</i> @ 5%	18	14.56 (3.82) <sup>bc</sup>	11.85 (3.44) <sup>ef</sup>	8.11 (2.85) <sup>e</sup>	11.51 (3.39) <sup>e</sup>	14.77 (3.84) <sup>d</sup>	11.4 (3.38) <sup>fg</sup>	11.65 (3.41) <sup>cd</sup>	11 (3.32) <sup>d</sup>	11.11 (3.33) <sup>e</sup>	6.1 (2.47) <sup>e</sup>	9.40 (3.07) <sup>de</sup>	10.85 (3.29) <sup>efg</sup>	47.79
<i>Vitex negundo</i> @ 5%	18.4	14.39 (3.79) <sup>bc</sup>	11.45 (3.38) <sup>de</sup>	7.2 (2.68) <sup>d</sup>	11.01 (3.32) <sup>e</sup>	14 (3.74) <sup>c</sup>	9.2 (3.03) <sup>d</sup>	10.35 (3.22) <sup>bcd</sup>	11.8 (3.44) <sup>e</sup>	10 (3.16) <sup>d</sup>	6 (2.45) <sup>e</sup>	9.27 (3.04) <sup>de</sup>	10.21 (3.20) <sup>de</sup>	50.89
<i>Azadirachta indica</i> @ 5%	18.5	14.8 (3.85) <sup>ef</sup>	12.21 (3.49) <sup>f</sup>	7.9 (2.81) <sup>e</sup>	11.64 (3.41) <sup>e</sup>	17 (4.12) <sup>f</sup>	11.8 (3.44) <sup>fg</sup>	12.82 (3.58) <sup>d</sup>	12.9 (3.59) <sup>f</sup>	12 (3.46) <sup>f</sup>	8 (2.83) <sup>e</sup>	10.97 (3.31) <sup>e</sup>	11.81 (3.44) <sup>fg</sup>	43.21
NSKE@5%	17.8	12.4 (3.52) <sup>b</sup>	6.8 (2.61) <sup>b</sup>	3.8 (1.95) <sup>b</sup>	7.67 (2.77) <sup>b</sup>	13 (3.61) <sup>b</sup>	6.8 (2.61) <sup>b</sup>	7.97 (2.82) <sup>b</sup>	8.5 (2.92) <sup>b</sup>	6.11 (2.47) <sup>b</sup>	4 (2.00) <sup>b</sup>	6.20 (2.49) <sup>b</sup>	7.28 (2.70) <sup>b</sup>	64.98
Neem oil @ 3%	18.3	13.45 (3.67) <sup>c</sup>	11.2 (3.35) <sup>d</sup>	5.9 (2.43) <sup>e</sup>	10.18 (3.19) <sup>bc</sup>	14 (3.74) <sup>c</sup>	8.7 (2.95) <sup>e</sup>	9.60 (3.10) <sup>bc</sup>	10 (3.32) <sup>d</sup>	7.9 (2.81) <sup>e</sup>	4.2 (2.05) <sup>b</sup>	7.37 (2.71) <sup>bc</sup>	9.05 (3.01) <sup>e</sup>	56.46
Karanj oil @ 3%	19	14.22 (3.77) <sup>d</sup>	8.2 (2.86) <sup>e</sup>	4.11 (2.03) <sup>b</sup>	8.84 (2.97) <sup>bc</sup>	14.88 (3.86) <sup>d</sup>	10.3 (3.21) <sup>d</sup>	10.69 (3.27) <sup>cd</sup>	11 (3.32) <sup>d</sup>	8 (2.83) <sup>e</sup>	6 (2.45) <sup>e</sup>	8.33 (2.89) <sup>e</sup>	9.29 (3.05) <sup>cd</sup>	55.32
Imidachoprid 0.0036%	18	10.4 (3.22) <sup>a</sup>	5.1 (2.26) <sup>a</sup>	2.5 (1.58) <sup>a</sup>	6.00 (2.45) <sup>bc</sup>	8.5 (2.92) <sup>a</sup>	3.9 (3.90) <sup>a</sup>	5.30 (2.30) <sup>a</sup>	6 (2.45) <sup>b</sup>	4.5 (2.12) <sup>a</sup>	1 (1.00) <sup>a</sup>	3.83 (1.96) <sup>a</sup>	5.04 (2.25) <sup>a</sup>	75.73
Untreated control	18	21.1 (4.59) <sup>g</sup>	22 (4.69) <sup>g</sup>	24 (4.90) <sup>f</sup>	22.37 (4.73) <sup>d</sup>	18 (4.24) <sup>f</sup>	20 (4.47) <sup>f</sup>	20.00 (4.47) <sup>f</sup>	21 (4.58) <sup>g</sup>	19 (4.36) <sup>g</sup>	20 (4.47) <sup>f</sup>	20.00 (4.47) <sup>f</sup>	20.79 (4.56) <sup>h</sup>	-
SED	NS	0.03	0.04	0.04	0.25	0.04	0.03	0.23	0.04	0.04	0.03	0.17	0.08	-
CD 5%	NS	0.07	0.08	0.08	0.52	0.09	0.06	0.48	0.08	0.08	0.06	0.35	0.18	-

DAS: Days after spraying, PTC: Pre-treatment count. \*Grand mean formed by making average values of 3rd, 5th and 10th days after treatment through the means of three replications of two rounds of spray. Figures in parentheses square root transformed values. In a column, means followed by common letter not significantly different by LSD (p=0.05)

Table 3. Effect of different botanicals on Groundnut yield and cost benefit ratio at Aruppukottai Block, Virudhunagar, Tamil Nadu, India

Treatments	Average grain yield (kg/ha)	Per cent increase over control	Total return (Rs/ha)	Realization over control (Rs/ha)	Cost of treatments (Rs/ha)	B:C ratio
<i>Calotropis gigantea</i> @5%	1126 (33.56) <sup>fg</sup>	19.18	90080	17280	45040	2.2
<i>Acorus calamus</i> @ 2%	1252 (35.38) <sup>e</sup>	27.32	100160	27360	50080	2.4
<i>Nerium indicum</i> @5%	1172 (34.23) <sup>f</sup>	22.35	93760	20960	46880	2.3
<i>Vitex negundo</i> @ 5%	1285 (35.85) <sup>de</sup>	29.18	102800	30000	51400	2.5
<i>Azadirachta indica</i> @ 5%	1057 (32.51) <sup>g</sup>	13.91	84560	11760	42280	2.1
NSKE@5%	1503 (38.77) <sup>b</sup>	39.45	120240	47440	60120	2.9
Neem oil @ 3%	1390 (37.28) <sup>c</sup>	34.53	111200	38400	55600	2.7
Karanj oil @ 3%	1355 (36.81) <sup>cd</sup>	32.84	108400	35600	54200	2.6
Chloropyifos 20% EC	1655 (40.68) <sup>a</sup>	45.02	132400	59600	66200	3.2
untreated control	910 (30.17) <sup>h</sup>		72800	-	36400	1.8
SEd	0.51					
CD (P=0.05%)	1.09					

Figures in parentheses are square root transformed values. In column, means followed by same letters are not significantly different at  $P=0.05$  by LSD

Table 4. Effect of different botanicals on Groundnut yield and cost benefit ratio at Narikudi Block, Virudhunagar, Tamil Nadu, India

Treatments	Average grain yield (Kg/ha)	Per cent increase over control	Total return (Rs/ha)	Realization over control (Rs/ha)	Cost of treatments (Rs/ha)	B:C ratio
<i>Calotropis gigantea</i> @5%	1141 (33.78) <sup>e</sup>	23.09	91280	17120	45040	2.5
<i>Acorus calamus</i> @ 2%	1267 (35.59) <sup>d</sup>	36.68	101360	101360	50080	2.8
<i>Nerium indicum</i> @5%	1187 (34.45) <sup>e</sup>	28.05	94960	94960	46880	2.6
<i>Vitex negundo</i> @ 5%	1300 (36.06) <sup>d</sup>	40.24	104000	104000	51400	2.8
<i>Azadirachta indica</i> @ 5%	1090 (33.02) <sup>f</sup>	17.58	87200	87160	42280	2.4
NSKE@5%	1512 (38.88) <sup>b</sup>	63.11	120960	120920	60120	3.3
Neem oil @ 3%	1411 (37.56) <sup>c</sup>	52.21	112880	112840	55600	3.1
Karanj oil @ 3%	1360 (36.88) <sup>c</sup>	46.71	108800	108760	54200	3.0
Chloropyifos 20% EC	1615 (40.19) <sup>a</sup>	74.22	129200	129160	66200	3.4
untreated control	927 (30.45) <sup>g</sup>		74160	-	36400	2.0
SEd	0.33					
CD (P=0.05%)	0.69					

Figures in parentheses are square root transformed values. In column, means followed by same letters are not significantly different at  $P=0.05$  by LSD



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