International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(5): 4505-4507
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Received: 25-07-2019
Accepted: 27-08-2019

V Abarna
Department of Agricultural Entomology, Agricultural College and Research Institute, Tamil Nadu Agricultural University (TNAU), Madurai, Tamil Nadu, India

DS Rajavel
Department of Agricultural Entomology, Regional Research Station, Aruppukottai

C Muthiah
Department of plant protection, Horticulture College & Research Institute. Periyakulam, Tamil Nadu, India

VK Paulpandi
Agricultural College & Research Institute, TNAU, Madurai, Tamil Nadu, India

B Bhakiyathu Saliha
Agricultural College & Research Institute, TNAU, Killikulam, Tamil Nadu, India

M Murugan
Department of Agricultural Entomology, TNAU, Coimbatore, Tamil Nadu, India

Corresponding Author:
V Abarna
Department of Agricultural Entomology, Agricultural College and Research Institute, Tamil Nadu Agricultural University (TNAU), Madurai, Tamil Nadu, India

Evaluation of botanicals against *Aphis craccivora* Koch (Hemiptera: Aphididae) in groundnut

V Abarna, DS Rajavel, C Muthiah, VK Paulpandi, B Bhakiyathu Saliha and M Murugan

Abstract
Field experiments were conducted during *Kharif* 2017-2018 at Aruppukottai, Virudthunagar, Tamil Nadu, India to evaluate the efficacy of various botanicals against *Aphis craccivora* Koch (Hemiptera: Aphididae) on groundnut under rain-fed conditions. Among them, neem seed kernel extract (NSKE) at 5% were found to effective against *A. craccivora* (67.9%) than untreated control. Similarly, neem oil @ 3% was also found to effective against *A. craccivora* (65.2%). To summarize, NSKE 5% and neem oil 3% can be included in IPM programs since they were effective in controlling *A. craccivora* (>50 % reduction).

Keywords: Population, mortality, bio-efficacy, Aphididae, Hemiptera, India

Introduction
In India, Groundnut is a principal oilseed crop is grown in 11 states in an area of 5.98 million ha, with a production of 6.2 mt and an average productivity of 1400 kg/ha (Anonymous, 2018) [1]. Major groundnut growing states are Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra accounting >80% of the total acreage and production. In Tamil Nadu, it is grown in an area of 0.34 million ha and production of 0.78 mt (Anonymous, 2018) [1]. The actual yield of farmers field are quite low because of insect pests and diseases. More than 350 species of insect pests are recorded to damage the groundnut (Stalker *et al*., 1983) [8]. *Aphis craccivora* is a regular serious pest of groundnut. It causes pod loss upto 40 per cent (Jena and Kuila, 1997) [3]. Indiscriminate and regular use of broad spectrum insecticides has caused turbulence in the environment consequently led to many undesirable problems like development of resistance, pest resurgence and secondary pest outbreak. The unilateral approach of controlling this pest by synthetic insecticides has necessitated in developing cost effective, eco-friendly and safe pest control strategies without using any chemical toxicants which suits well in organic farming. Thus, the present study was undertaken to evaluate the efficiency of the various botanicals against *A. craccivora* in groundnut.

Materials and Methods
The field experiment was conducted at Aruppukottai, Virudhunagar, Tamil Nadu, India during *Kharif* 2017 and 2018. Treatments were applied to 3 replicates arranged in a Randomized Complete Block Design (RCBD). Application was made when the aphids crossed ETL level (5-10 aphids per inch terminal shoots). 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 aphid population was observed. The pre-treatment count was made at 24 h 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 Chloropyifos 20% EC of 2.5 m/L. Spraying was taken up during early morning using high volume Knapsack sprayer (manufacturer: ASPEE India, Mumbai, Maharashtra, India and model: SRP/50) with hallow cone nozzle. The nymph and adult counts numbers per trifoliate leaves were pooled are transformed to square roots (x + 0.5) before analysis and the means were compared by using LSD. The analysis of variance was carried out using AGRES and AGDATA software.

Result and Discussion

Result obtained from the field experiment conducted to evaluate the effect of different botanicals against *A. craccivora* are presented in Table 1. The average aphid population ranged from 30.00 to 31.1 /inch terminal shoot. These were found to be statistically non-significant, thereby the aphid 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 (11.63 /inch terminal shoot) than other treatments. The next better treatment was Neem oil @ 3% (12.46 /inch terminal shoot).

The results further revealed that the second spray with NSKE @ 5% was consistently most effective (12.26 /inch terminal shoot) as compared to other treatments. Similarly, the next best treatment was Neem oil @ 3% (13.1 /inch terminal shoot) followed by Karanji oil @ 3% (13.7 /inch terminal shoot) and *Vietx negundo* @ 5 % (14.13 /inch terminal shoot). However, *Acorus calamus* @ 2% (15.03 /inch terminal shoot), and *Nerium indicum* @ 5% (16.16 /inch terminal shoot) were found to be less effective.

NSKE @ 5% was consistently the most effective botanical (7.83 /inch terminal shoot) compared to other botanicals during third spray. It showed prolonged residual efficacy compared to other botanicals. The next better treatment was neem oil @ 3% (8.7 /inch terminal shoot), followed by karanji oil @ 3% (9.06 /inch terminal shoot), *Vitex negundo* @ 5% (9.8 /inch terminal shoot), *Acorus calamus* @ 2% (10.53 /inch terminal shoot) and *Nerium indicum* @ 5% (12.06 /inch terminal shoot).

The highest reduction over control due to the application of NSKE @ 5% (67.9%) neem oil @ 3% (65.2%) and karanji oil @ 3% (63.7%) were found to be most effective botanicals in controlling the *A. craccivora*. However, the lowest reduction over control was recorded in neem leaf extract 5% (49.3%). The present investigation is in accordance with the report of Krishna Naiak *et al*. (2017) who reported that NSKE 5% had significant reduced the jassid population. Similarly, Rajamanikam *et al*. (1997) [4], Srinivasalu *et al*. (1999) [7] and Bharathi *et al*. (2005) [2] observed that application of NSKE 5% was found to be more effective against *E. Kerri*. Earlier, Srinivasalu *et al*. (1999) [7] reported that application of neem oil 3% was most effective against jassid than commercial neem formulation. Sathapathi and Ahatak (1990) [6] observed that karanji oil was effective against *Plutella xylostella* (L.) in cabbage. Saradamma (1989) [5] reported that acetone extracts of *Vitex negundo* (2%) resulted in 100% mortality of *Spodoptera litura* (F.) in groundnut.

Table 1: Effect of botanicals on *Aphis craccivora* population on groundnut at Virudhunagar, Tamil Nadu, India

Treatments	No. of aphids / inch terminal shoot on DAT*										MEAN	% reduction over control
	Pre-count	1ST SPRAY			2ND SPRAY			3RD SPRAY				
		3DAS	5DAS	10DAS	3DAS	5DAS	10DAS	3DAS	5DAS	10DAS		
Calotropis gigantean @ 5%	30.1 (5.48)	23.4 (4.83)^{ef}	14.7 (3.83)^{g}	7.2 (2.68)^{g}	24.2 (4.91)^{ef}	16.2 (4.02)^{f}	6.8 (2.60)^{g}	15.7 (3.92)^{f}	12.6 (3.54)^{f}	6.1 (4.75)^{de}	14.1 (3.73)^{ef}	57.0
Acorus calamus @ 2%	30.1 (5.48)	22.6 (4.75)^{de}	13.4 (3.66)^{f}	6.6 (2.56)^{f}	23.6 (4.85)^{def}	15.3 (3.91)^{e}	6.2 (2.49)^{f}	14.7 (3.83)^{e}	11.3 (3.36)^{e}	5.6 (2.36)^{f}	13.2 (3.62)^{e}	59.7
Nerium indicum @ 5%	31.1 (5.57)	23.8 (4.87)^{f}	15.7 (3.46)^{h}	7.7 (2.77)^{h}	24.8 (4.97)^{f}	16.6 (4.07)^{f}	7.1 (2.66)^{h}	16.5 (4.05)^{g}	13.2 (3.63)^{g}	6.5 (2.55)^{h}	14.6 (3.81)^{f}	55.4
Vitex negundo @ 5%	31.1 (5.57)	22.2 (4.71)^{cd}	12.6 (3.55)^{e}	5.8 (2.40)^{e}	23.1 (4.80)^{cde}	13.8 (3.71)^{d}	5.5 (2.34)^{e}	13.7 (3.70)^{d}	10.5 (3.24)^{d}	5.2 (2.27)^{e}	12.4 (3.51)^{d}	62.1
Azadirachta indica @ 5%	30.0 (5.48)	27.4 (5.23)^{g}	17.8 (4.21)^{i}	8.5 (2.91)^{i}	28.4 (5.32)^{g}	19.5 (4.41)^{g}	8.1 (2.84)^{i}	18.3 (4.47)^{h}	14.7 (3.83)^{h}	7.3 (2.69)^{i}	16.6 (4.07)^{g}	49.3
NSKE@5%	30.0 (5.47)	20.7 (4.54)^{b}	10.1 (3.17)^{b}	4.1 (2.02)^{b}	21.5 (4.63)^{ab}	11.4 (3.37)^{b}	3.9 (1.97)^{b}	11.3 (3.36)^{b}	8.6 (2.93)^{b}	3.6 (1.89)^{b}	10.5 (3.22)^{b}	67.9
Neem oil @ 3%	31.0 (5.57)	21.4 (4.62)^{bc}	11.2 (3.34)^{c}	4.8 (2.18)^{c}	22.3 (4.72)^{bc}	12.5 (3.53)^{c}	4.5 (2.12)^{c}	12.4 (3.52)^{c}	9.5 (3.08)^{c}	4.2 (2.04)^{c}	11.4 (3.37)^{c}	65.2
Karanj oil @ 3%	30.0 (5.48)	21.9 (4.67)^{cd}	11.8 (3.43)^{d}	5.3 (2.30)^{d}	22.8 (4.77)^{cd}	13.4 (3.66)^{d}	5.0 (2.23)^{d}	12.8 (3.75)^{c}	9.9 (3.14)^{c}	4.5 (2.12)^{d}	11.9 (3.45)^{cd}	63.7
Chloropyifos 20% EC	31.0 (5.57)	19.6 (4.42)^{a}	9.3 (3.05)^{a}	3.2 (1.78)^{a}	20.9 (4.56)^{a}	10.5 (3.24)^{a}	2.8 (1.67)^{a}	10.2 (3.19)^{a}	6.4 (2.52)^{a}	2.4 (1.54)^{a}	9.4 (3.06)^{a}	71.3
Untreated control	31.1 (5.58)	32.3 (5.68)^{h}	34.6 (5.88)^{j}	37.5 (6.12)^{j}	30.2 (5.49)^{h}	32.5 (5.70)^{h}	35.7 (5.97)^{j}	28.3 (5.32)^{i}	30.4 (5.51)^{i}	33.8 (5.81)^{j}	32.8 (5.72)^{h}	-
SEd	NS	0.05	0.03	0.03	0.05	0.02	0.02	0.03	0.03	0.02	0.04	-
CD 5%	NS	0.10	0.06	0.07	0.12	0.04	0.06	0.06	0.07	0.04	0.09	-

*Mean of three replications; DAT – Days after treatment
NS-Non significant
Figures in parentheses are square root transformed values
Mean in a column followed by same letters are not significantly different (P=0.05) by LSD.

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