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Laboratory evaluation of insecticides and biopesticides against pomegranate aphid *Aphis punicae* Passerini

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Abstract
Pomegranate aphid *Aphis punicae* Passerini (Hemiptera: Aphididae) is one of the most important pest in pomegranate orchard in India. Under laboratory imidacloprid 17.8 SL(0.00712%), thiamethoxam 25 WG (0.005%), chlorantraniliprole 18.5 SC (0.0037%), dichlorvas 76% EC (0.076%), dimethoate 30% EC(0.06%), fipronil 5% SC(0.01%) and bio pesticides azadirachtin 10000 ppm (0.02%), spinosad 45% SC (0.0125%), NSKE 5%, horticultural mineral oil 0.2% (0.2%), *Beauveria bassiana* ($1x10^9$ cfu/g) and *Lecanicillium lecanii* ($1x10^8$ cfu/g) at the recommended concentration was evaluated against of *A. punicae* at the Department of Agricultural Entomology, Tamil Nadu Agricultural University, Coimbatore during 2016. The study revealed that dichlorvas 76% EC (0.076%), imidacloprid 17.8 SL (0.00712%) and dimethoate 30% EC (0.06%) were effective with the maximum mortality of 96.6, 94.4 and 92.2 per cent at 48 hours after treatment followed by chlorantraniliprole 18.5 SC (0.0037%) and thiamethoxam 25 WG (0.005%), which recorded mortality of 84.4 and 83.3 per cent at the same period of observation. Among bio pesticides spinosad 45% SC treatment showed maximum mortality of aphids 54.4 and 75.5 per cent at 24 and 48 hours after treatment.

Keywords: Pomegranate, Bioassay, *Aphis Punicae*, spinosad 45% SC

Introduction
Pomegranate one of the important fruit crop in India is being cultivated in arid and semiarid regions of Gujarat, Maharashtra, Karnataka, Uttar Pradesh, Andhra Pradesh and Tamil Nadu (Balikai *et al.*, 2011) [3]. In Tamil Nadu, the concept of high density planting and ultra-high density planting is being introduced and followed in pomegranate and mango. Pomegranate is cultivated under high density planting in important districts of Tamil Nadu *viz.*, Coimbatore, Erode, Tiruppur and Karur. The cultivation of crop under high density demands the study on the level occurrence of various pests and their related natural enemies.

The pomegranate aphid, *Aphis punicae* Passerini (Hemiptera: Aphidiae) feeds on leaves and tender shoots. It causes severe damage to flowers, fruits, twigs and leaves by desapping, which results in loss of quality of fruits and reduction in yield (Karuppuchamy *et al.*, 1998) [6]. Though it was considered as minor pest, in recent years, it has assumed a serious form (Balikai *et al*., 2009) [4]. It was also observed that infestation resulted in significant flower and immature fruit drop (Sreedevi and Abraham Verghese, 2009) [8]. Though, chemicals pesticides are recommended, there is a need to screen the new and eco-friendly molecules for their efficacy and economic feasibilities. The present investigation was planned to evaluate such new insecticides imidacloprid 17.8 SL(0.00712%), thiamethoxam 25 WG (0.005%), chlorantraniliprole 18.5 SC (0.0037%), dichlorvas 76% EC (0.076 %), dimethoate 30% EC(0.06%), fipronil 5% SC(0.01%) and bio pesticides azadirachtin 10000 ppm (0.02%), spinosad 45% SC (0.0125%), NSKE 5%, horticultural mineral oil (0.2%), *Beauveria bassiana* ($1x10^9$ cfu/g) and *Lecanicillium lecanii* ($1x10^8$ cfu/g) against pomegranate aphid.

Materials and methods
Mass culturing of test insect
The adult aphid was collected from infested twigs and released on the pomegranate seedlings in the pot kept under net house at Department of Agricultural Entomology, Tamil Nadu Agricultural University, Coimbatore. In order to increase the infestation, the plant was supplied with more nitrogen fertilizer and exposed to sunlight with the little watering. The population of aphids established in the potted plant was used for the laboratory studies.

Bioassay

The efficacy of neem seed kernel extract, horticultural mineral oil, entomopathogens and chemical pesticides to aphid was assessed under laboratory condition in the Department of Agricultural Entomology, Tamil Nadu Agricultural University, Coimbatore.

Leaf dip bioassay

Fresh leaves of pomegranate were dipped in different insecticide solution for one minute. The leaves treated with treatment solution was shade dried on a filter paper in open air and thirty aphid adults were released on the treated leaves kept inside the plastic container. Small pin holes were made on top of the container for ventilation. Totally three replications were maintained for each treatment. Based on the mobility of body parts and change in the colour of the body the mortality of aphid was confirmed and the data recorded at 24 and 48 hours after treatment (HAR). The experiment was conducted using Completely Randomized Design (CRD).

Contact bioassay

Fresh leaves of pomegranate were placed in a plastic container along with thirty aphids. The treatment solution was sprayed directly on the leaf with aphids in plastic container. Totally three replications were maintained for each treatment. The mortality of aphid was assessed based on the mobility of body parts and change in the colour of the body at 24 and 48 HAT and expressed as percent mortality. The experiment was conducted using Completely Randomized Design (CRD)

Statistical analysis

The data collected under laboratory experiments in completely randomized design were analyzed using analysis of variance (ANOVA) using AGRES 3.01 and AGDATA software. Data in the form of percentages were transformed to arcsine values and those in numbers were transformed to $\sqrt{x}+0.5$ and analyzed. The mean values of the treatments were compared using DMRT at 5 per cent level of significance

Results

Results of the laboratory studies conducted to assess the toxicity of pesticides to aphids through contact method revealed that dichlorvas 76% EC (0.076%), imidacloprid 17.8 SL (0.00712%) and dimethoate 30% EC (0.06%) were found effective with the maximum mortality of 96.6, 94.4 and 92.2 per cent. In leaf dip method imidacloprid 17.8 SL (0.00712%) recorded 58.8 and 84.4 per cent mortality of aphids 24 and 48 hours after treatment respectively.

Among plant products, mineral oil and entomopathogens studied against aphids through contact method maximum mortality of aphids was noted spinosad 45% SC (0.0125%) 54.4 and 75.5 per cent at 24 and 48 HAT. Whereas, in leaf dip method spinosad 45% SC (0.0125%) registered 44.4 and 64.4 per cent mortality of aphids respectively, during 24 and 48 hours of treatment, this was followed by neem seed kernel extract 5% caused 33.3 and 56.6 per cent mortality of aphids 24 and 48 hours after treatment respectively.

Discussion

This result corroborate with the findings of Aswathanarayana Reddy *et al.* (2014) [1] stated that thiamethoxam 25 WG at 0.20g /l and imidacloprid 17.8 SL at 0.25 ml/l were significantly superior comparing to other treatment with maximum per cent reduction of aphids in pomegranate. Reports of Kambrekar *et al.* (2013) [5] that thiamethoxam 25 WG at 0.2 g/L recorded highest reduction in aphid population followed by imidacloprid 70 WG at 0.3 g/L was also further strengthens the present result. Maximum mortality of aphid was obtained (75.5 per cent) with spinosad 45% SC (0.0125%) at 48 hours after treatment whereas azadirachtin 10000 ppm (0.02%)and neem seed kernel extract 5% showed 54.4 and 51.1 per cent mortality respectively after 48 hours of treatment. Aziz *et al.* (2013) [2] reported neem seed oil as effective as imidacloprid in controlling the aphids, while except neem seed cake extract, all other treatments were statistically on par with imidacloprid. (Radha, 2013) [7] Reported cowpea aphid *Aphis craccivora* was effectively controlled using spinosad followed by neem seed kernel extract. These results also confirms the result obtained in the present study.

Table 1: Toxicity of insecticides to aphid (*Aphis punicae)* under laboratory condition

Treatments	Dosage (g or ml per litre)	Mortality of aphid (%)						Overall Mean mortality (%)
		Contact bioassay			Leaf dip bioassay			
		Hours after treatment (HAT)			Hours after Release (HAR)			
		24	48	Mean mortality	24	48	Mean mortality	
T_1- Imidacloprid 17.8 SL (0.00712%)	0.4	78.88 (62.64)^{ab}	94.44 (76.36)^{ab}	86.66	58.88 (50.11)^{a}	84.44 (66.76)^{a}	71.66	79.16
T_2-Thiamethoxam 25 WG (0.005%)	0.2	68.88 (56.09)^{cd}	83.33 (65.90)^{cd}	76.10	51.11 (45.63)^{a}	70.00 (56.79)^{bc}	60.55	68.32
T_3-Chlorantraniliprole 18.5 SC (0.0037%)	0.2	62.22 (52.07)^{d}	84.44 (66.76)^{bcd}	73.33	37.77 (37.92)^{b}	60.00 (50.76)^{c}	48.88	61.10
T_4-Dichlorvas 76% EC (0.076 %)	2	84.44 (66.76)^{a}	96.66 (79.47)^{a}	90.55	37.77 (37.92)^{b}	67.77 (55.41)^{bc}	52.77	71.66
T_5- Dimethoate 30% EC (0.06%)	1	76.66 (61.11)^{bc}	92.22 (73.80)^{abc}	84.44	41.11 (39.88)^{b}	71.11 (57.48)^{b}	56.11	70.27
T_6-Fipronil 5% SC (0.01%)	2	70.00 (56.79)^{cd}	78.88 (62.64)^{d}	74.44	40.00 (39.23)^{b}	64.44 (53.39)^{c}	52.22	63.33
T_7-Untreated control	--	0.00 (0.00)^{e}	0.00 (0.00)^{e}	0.00	0.00 (0.00)^{c}	0.00 (0.00)^{d}	0.00	0.00
SE d	--	2.6218	5.6910	--	2.4708	3.0046	--	--

Table 2: Toxicity of bio pesticides to aphid (*Aphis punicae)* under laboratory condition

Treatments	Dosage (g or ml per litre)	Mortality of aphids (%)						Overall Mean mortality (%)
		Contact bioassay			Leaf dip bioassay			
		Hours after treatment (HAT)			Hours after Release (HAR)			
		24	48	Mean mortality	24	48	Mean mortality	
T_1-Azadirachtin 10000 ppm (0.02%)	2	38.88 (38.57)^{b}	54.44 (47.54)^{b}	46.66	34.44 (35.93)^{b}	52.22 (46.27)^{b}	43.33	44.98
T_2- Spinosad 45% SC (0.0125%)	0.2	54.44 (47.54)^{a}	75.55 (60.36)^{a}	64.99	44.44 (41.80)^{a}	64.44 (53.39)^{a}	54.44	59.71
T_3-NSKE (5%)	50	36.66 (37.26)^{b}	51.11 (45.63)^{b}	43.88	33.33 (35.26)^{bc}	56.66 (48.82)^{ab}	44.99	44.43
T_4-Horticultural mineral oil (0.2%)	2	21.11 (27.35)^{c}	28.88 (32.50)^{c}	24.99	24.44 (29.62)^{cd}	38.88 (38.57)^{c}	31.66	28.32
T_5-*Beauveria bassiana* ($1x10^9$ cfu/g)	2	16.66 (24.09)^{c}	36.66 (37.26)^{c}	26.66	15.55 (23.22)^{e}	30.00 (33.21)^{d}	22.77	24.71
T_6-*Lecanicillium lecanii* ($1x10^8$ cfu/g)	2	20.00 (26.56)^{c}	34.44 (35.93)^{c}	27.22	22.22 (28.12)^{de}	38.88 (38.57)^{cd}	30.55	28.88
T_7-Untreated control	--	0.00 (0.00)^{d}	0.00 (0.00)^{d}	0.00	0.00 (0.00)^{f}	0.00 (0.00)^{f}	0.00	0.00
SE d		3.6215	3.5237	--	2.6353	2.8322	--	--

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