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K Appala Raju
Research Scholar, Department of Agricultural Entomology, Mahatma Phule Krishi Vidyapeeth (M.P.K.V.), Rahuri, Maharashtra, India

CS Patil
Head, Department of Agricultural Entomology, M.P.K.V, Rahuri, Maharashtra, India

SR Kulkarni
Professor, Department of Agriculture Entomology, Agricultural College, Pune, Maharashtra, India

SS Kulkarni
Horticulturist , AICRP on Arid Zone Fruits, Department of Horticulture, M.P.K.V, Rahuri, Maharashtra, India

AR Walunj
Assistant professor, AICRP on Arid Zone Fruit, Department of Horticulture, M.P.K.V, Rahuri, Maharashtra, India

BV Deore
Assistant Residue Analyst, AINP on Pesticide Residues, Department of Entomology, M.P.K.V, Rahuri, Maharashtra, India

Corresponding Author:
K Appala Raju
Research Scholar, Department of Agricultural Entomology, Mahatama Phule Krishi Vidyapeeth (M.P.K.V.), Rahuri, Maharashtra, India

Bio-efficacy of newer insecticides against pomegranate aphid, *Aphis punicae*

K Appala Raju, CS Patil, SR Kulkarni, SS Kulkarni, AR Walunj and BV Deore

Abstract
A field experiment was conducted during the *Ambia bahar* 2018 in the orchard of All India Coordinated Research Project on Arid Zone fruits, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth (M.P.K.V.), Rahuri, Ahmednagar, India to evaluate the efficacy of newer insecticides against pomegranate aphids. The pooled data inferred that Spirotetramat + Imidacloprid 240 SC was the most effective treatment in keeping population of aphids at lowest level (3.99 aphids/shoot). The next treatments in the ascending order of superiority were Fipronil 5 SC (4.30), Cyantraniliprole 10.26 OD (4.40), Tolfenpyrad 15 EC (6.27), Thiacloprid 240 SC (6.29), Imidacloprid 200 SL (7.26) & Acetamiprid 20 SP (7.58).

Keywords: Bio-efficacy, insecticides, pomegranate, *Aphis punicae*

1. Introduction
Pomegranate (*Punica granatum*) is well known arid zone horticultural crop grown all over the world and more extensively cultivated in Mediterranean countries like Spain, Afghanistan and to some extent in United States, China, Japan and Russia. It belongs to family Lythraceae. An attractive shrub or small tree, with average height of 10-20 feet, the pomegranate is much-branched, more or less spiny and extremely long-lived. The leaves are evergreen or deciduous, showy flowers are singly or in cluster form. Pomegranate crop grows best on deep, heavy loams, but are adapted to many soil types from pure sand to heavy clay. Growth on alkaline soil is poor. Optimum growth is associated with deep fairy heavy, moist soil of pH (5.5-7.0) [1]. In india, it is grown on an area of about 2,34,000 ha with a production of 28,45,000 tones & a productivity of 11.6 t/ha. Maharashtra is the leading producer of pomegranate as the plantation reached up to 1,47,000 ha in 2017-18, with the production of 17,89,000 t. In Maharastra, Nashik (area – 38,000 ha, production – 6,28,000 t), Solapur (area - 25,000 ha, production – 2,29,000 t), Ahmednagar (area – 21,000 ha, production – 2,15,000 t), Pune (area – 13,000 ha, production – 1,36,000 t) are the major pomegranate producing districts [2].
Insect pests and diseases play significant role in reducing the productivity of this crop. The pomegranate crop suffers from the attack of several insect and non-insect pests. Eighty six species of insect pests infesting pomegranate have been reported from various parts of the world. Among them sucking pests like aphids (*Aphis punicae*), thrips (*Scirtothrips dorsalis*) and fruit borer (*Deudorix isocrates*) causes yield loss up to 40% in pomegranate cultivation**.**
Pomegranate aphid, *Aphis punicae* (Aphididae: Homoptera) is a economically important pest. The adults and nymphs colonize on tender shoots, flower buds, flowers and young fruits and suck sap therein. The affected parts get discolored and severe infestation results in stunted growth and drying of tender parts. In addition, the excretion of honeydew by aphids attract black sooty mould, which hinders the photosynthetic activity. All these affect the development of fruit and cause considerable yield loss [3].
In order to protect the crop from these pest problems, farmers are spraying a number of chemical pesticides on this crop. Such indiscriminate use of pesticides leads to problem of development of resistance, resurgence, environmental pollution and health hazards. Pesticide residue in fruits has affected exports in recent years and should be strictly monitored. Since this fruit is mostly accepted as a table purpose fresh fruit, pesticide residues in this crop are of very much concern.

2. Materials and Methods
The field experiments were conducted during the *Ambia bahar* 2018 in the orchard of All India Coordinated Research Project on Arid Zone fruits, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth (M.P.K.V.), Rahuri, Ahmednagar, India. The spacing of plantation

was 4.5 m x 3.0 m. The experiment was laid out in a Randomized Block Design (RBD). Two trees together treated as one unit. All trees in the block were kept free from application of insecticides. All other agronomical practices were followed as per the recommendations made by M.P.K.V., Rahuri.

Table 1: Details of field experimentation

Design	:	Randomized Block Design
Replications	:	3
Crop, Variety & Season	:	Pomegranate (Bhagwa), *Ambia bahar* 2018
Spacing	:	4.5 X 3.0 m
No. of sprays	:	2

2.1 Observations recorded
Number of nymphs and adult aphids were counted from five terminals (each of 5 cm shoot length) in five branches in a plant. The average number of aphids per shoot or fruit were worked out. The data obtained on population counts of aphids were transformed into square root values. Appropriate statistical methods are employed to work out standard error (SE) and critical difference (CD) for deciding the significance of treatments [4].

3. Results and Discussions
3.1 Bio efficacy of newer insecticides against aphids, *Aphis punicae* (*Ambia bahar* - 2018, 1st spray)
At 3 days after spray the results indicated that Fipronil 5 SC was the most effective treatment in keeping the population of aphids at lowest level (10.98). The next treatments in the ascending order of superiority were Spirotetramat + Imidacloprid 240 SC (11.56), Cyantraniliprole 10.26 OD (12.45), Thiacloprid 240 SC (14.98), Tolfenpyrad 15 EC (15.10), Imidacloprid 200 SL (16.08) & Acetamiprid 20 SP (17.10).

At 7 days after spray, the results indicated that Spirotetramat + Imidacloprid 240 SC was the most effective treatment in keeping population of aphids at lowest level (4.86). The next treatments in the ascending order of superiority were Fipronil 5 SC (5.45), Cyantraniliprole 10.26 OD (5.78), Tolfenpyrad 15 EC (6.84), Thiacloprid 240 SC (7.16), Imidacloprid 200 SL (8.98) & Acetamiprid 20 SP (9.10).

At 10 days after spray, the results indicated that Spirotetramat + Imidacloprid 240 SC was the most effective treatment in keeping population of aphids at lowest level (2.12). Similar trend in the order of superiority was observed on 10 DAS as observed on 7 DAS. The aphids per shoot as recorded by different treatments i.e. Fipronil 5 SC, Cyantraniliprole 10.26 OD, Tolfenpyrad 15 EC, Thiacloprid 240 SC, Imidacloprid 200 SL & Acetamiprid 20 SP was observed to be 2.45, 2.91, 3.45, 3.71, 4.14 & 4.74 aphids per shoot, respectively.

At 15 days after spray, the results indicated that Spirotetramat + Imidacloprid 240 SC was the most effective treatment in keeping population of aphids at lowest level (1.17). Similar trend in the order of superiority was observed on 15 DAS as observed on 7 DAS. The aphids per shoot as recorded by different treatments i.e. Fipronil 5 SC, Cyantraniliprole 10.26 OD, Tolfenpyrad 15 EC, Thiacloprid 240 SC, Imidacloprid 200 SL & Acetamiprid 20 SP was observed to be 1.48, 1.66, 2.86, 2.98, 3.10 & 3.45 aphids per shoot, respectively.

3.1.1 Mean population of 3, 7, 10 & 15 days after first spray
The results indicated that Spirotetramat + Imidacloprid 240 SC was the most effective treatment in keeping population of aphids at lowest level (4.92) and found at par with the treatment Fipronil 5 SC which recorded 5.09 aphids per shoot. The next treatments in the ascending order of superiority were, Cyantraniliprole 10.26 OD (5.70) & Tolfenpyrad 15 EC (7.06). Whereas, Thiacloprid 240 SC (7.20), Imidacloprid 200 SL (8.07) & Acetamiprid 20 SP (8.59) found at par with each other (Table 2).

3.2 Bio efficacy of newer insecticides against aphids, *Aphis punicae* (*ambia bahar* - 2018, 2nd spray)
At 3 days after spray, the results indicated that Cyantraniliprole 10.26 OD was the most effective treatment in keeping the population of aphids at lowest level (7.42). The next treatments in the ascending order of superiority were Spirotetramat + Imidacloprid 240 SC (7.61), Fipronil 5 SC (8.54), Tolfenpyrad 15 EC (10.12), Thiacloprid 240 SC (10.72), Imidacloprid 200 SL (11.96) & Acetamiprid 20 SP (12.10).

At 7 days after spray, the results indicated that Spirotetramat + Imidacloprid 240 SC was the most effective treatment in keeping the population of aphids at lowest level (2.54). The next treatments in the ascending order of superiority were Cyantraniliprole 10.26 OD (2.69), Fipronil 5 SC (3.11), Thiacloprid 240 SC (5.18), Tolfenpyrad 15 EC (6.06), Imidacloprid 200 SL (7.19) & Acetamiprid 20 SP (7.44).

At 10 days after spray, the results indicated that Spirotetramat + Imidacloprid 240 SC was the most effective treatment in keeping population of aphids at lowest level (1.07). Similar trend in the order of superiority was observed on 10 DAS as observed on 7 DAS. The aphids per shoot as recorded by different treatments i.e. Cyantraniliprole 10.26 OD, Fipronil 5 SC, Thiacloprid 240 SC, Tolfenpyrad 15 EC, Imidacloprid 200 SL & Acetamiprid 20 SP was observed to be 1.19, 1.28, 3.11, 3.14, 4.10 & 4.26 aphids per shoot, respectively.

At 15 days after spray, the results indicated that Spirotetramat + Imidacloprid 240 SC was the most effective treatment in keeping the population of aphids at lowest level (1.02). The next treatments in the ascending order of superiority were Cyantraniliprole 10.26 OD (1.08), Fipronil 5 SC (1.11), Acetamiprid 20 SP (2.41).Thiacloprid 240 SC (2.48), Imidacloprid 200 SL (2.50) & Tolfenpyrad 15 EC (2.61).

3.2.1 Mean population of 3, 7, 10 & 15 days after second spray
The results indicated that Spirotetramat + Imidacloprid 240 SC was the most effective treatment in keeping population of aphids at lowest level (3.06) and found at par with Cyantraniliprole 10.26 OD & Fipronil 5 SC which recorded 3.09 & 3.51 aphids per shoot, respectively. The next treatments were Thiacloprid 240 SC (5.37), Tolfenpyrad 15 EC (5.48), Imidacloprid 200 SL (6.43) & Acetamiprid 20 SP (6.55) (Table 3).

3.3 Overall bio efficacy against aphids, *Aphis punicae* (1st & 2nd spray)
The population of aphids per shoot in the overall bioefficacy of *ambia bahar*- 2018 are presented in Table 4. The results indicated that Spirotetramat + Imidacloprid 240 SC was the most effective treatment in keeping population of aphids at lowest level (3.99). The next treatments in the ascending order of superiority were Fipronil 5 SC (4.30), Cyantraniliprole 10.26 OD (4.40), Tolfenpyrad 15 EC (6.27), Thiacloprid 240 SC (6.29), Imidacloprid 200 SL (7.26) & Acetamiprid 20 SP (7.58).

The present finding are in accordance with [5] who evaluated the efficacy of spirotetramat + imidacloprid 240 SC against sucking pest complex in brinjal. The results revealed that spirotetramat + imidacloprid 240 SC @ 75 + 75 g a.i./ha was found more effective than other treatments in the reduction of the population of jassids (99.21%), whiteflies (99.04%) and red spider mites (91.31%), respectively. [6] also reported that spirotetramat + imidacloprid 240 SC @ 90 g + 90 g a.i./ha caused maximum reduction of aphids in chilli at 5 and 10 days after each spray. It also recorded the highest marketable yield of 133.08 q/ha. [7] evaluated spirotetramat 150 OD as foliar application for its bioefficacy against the cotton aphid, *Aphis gossypii*. The results revealed that spirotetramat 150 OD at 75 g a.i./ha was highly effective in checking the population of aphids. These earlier findings support the present investigations.

Table 2: Bio efficacy of newer insecticides against aphids (*Ambia bahar*-2018, first spray)

Tr. No.	Treatment	Dose/L	Number of aphids per shoot					
			Pre count	3 DAS	7 DAS	10 DAS	15 DAS	Mean
T1	Tolfenpyrad 15 EC	1 ml	25.16	15.10 (3.95)	6.84 (2.71)	3.45 (1.99)	2.86 (1.83)	7.06^{bc} (2.75)
T2	Cyantraniliprole 10.26 OD	0.9 ml	27.45	12.45 (3.60)	5.78 (2.51)	2.91 (1.85)	1.66 (1.47)	5.70^{ab} (2.49)
T3	Imidacloprid 200 SL	0.3 ml	26.43	16.08 (4.07)	8.98 (3.08)	4.14 (2.15)	3.1 (1.90)	8.07^{c} (2.93)
T4	Acetamiprid 20 SP	0.2 g	26.12	17.1 0 (4.20)	9.1 (3.10)	4.74 (2.29)	3.45 (1.99)	8.59^{c} (3.01)
T5	Thiacloprid 240 SC	0.8 ml	25.81	14.98 (3.93)	7.16 (2.77)	3.71 (2.05)	2.98 (1.87)	7.20^{c} (2.77)
T6	Fipronil 5 SC	2 ml	26.10	10.98 (3.39)	5.45 (2.44)	2.45 (1.72)	1.48 (1.41)	5.09^{a} (2.36)
T7	Spirotetramat + Imidacloprid 240 SC	0.3 ml	27.15	11.56 (3.47)	4.86 (2.32)	2.12 (1.62)	1.17 (1.29)	4.92^{a} (2.33)
T8	Untreated control	-	26.48	26.54 (5.20)	27.11 (5.25)	25.77 (5.13)	26.32 (5.18)	26.43^{d} (5.19)
	S.Em		-	0.12	0.09	0.07	0.06	0.09
	CD		NS	0.38	0.28	0.20	0.18	0.27

Figures in parentheses are √x+0.5 transformed values
Values with similar alphabets in each column do not vary significantly at 5% level

Table 3: Bio efficacy of newer insecticides against aphids (*Ambia bahar*-2018, second spray)

Tr. No.	Treatment	Dose/L	Number of aphids per shoot					
			Pre count	3 DAS	7 DAS	10 DAS	15 DAS	Mean
T1	Tolfenpyrad 15 EC	1 ml	17.64	10.12 (3.26)	6.06 (2.56)	3.14 (1.91)	2.61 (1.76)	5.48^{bc} (2.45)
T2	Cyantraniliprole 10.26 OD	0.9 ml	18.67	7.42 (2.81)	2.69 (1.79)	1.19 (1.30)	1.08 (1.26)	3.09^{a} (1.89)
T3	Imidacloprid 200 SL	0.3 ml	18.11	11.96 (3.53)	7.19 (2.77)	4.1 (2.14)	2.5 (1.73)	6.43^{bc} (2.63)
T4	Acetamiprid 20 SP	0.2 g	17.96	12.1 (3.55)	7.44 (2.82)	4.26 (2.18)	2.41 (1.71)	6.55^{c} (2.66)
T5	Thiacloprid 240 SC	0.8 ml	17.17	10.72 (3.35)	5.18 (2.38)	3.11 (1.90)	2.48 (1.73)	5.37^{b} (2.42)
T6	Fipronil 5 SC	2 ml	18.4	8.54 (3.01)	3.11 (1.90)	1.28 (1.33)	1.11 (1.27)	3.51^{a} (2.00)
T7	Spirotetramat + Imidacloprid 240 SC	0.3 ml	17.87	7.61 (2.85)	2.54 (1.74)	1.07 (1.25)	1.02 (1.23)	3.06^{a} (1.89)
T8	Untreated control		18.22	19.67 (4.49)	19.78 (4.50)	20.02 (4.53)	19.45 (4.47)	19.73^{d} (4.50)
	S.Em		-	0.10	0.08	0.06	0.05	0.08
	CD		NS	0.32	0.23	0.18	0.15	0.23

Figures in parentheses are √x+0.5 transformed values
Values with similar alphabets in each column do not vary significantly at 5% level

Table 4: Overall bio efficacy of newer insecticides against aphids (*Ambia bahar*-2018, first & second spray)

Tr. No.	Treatment	Dose/L	Number of aphids per shoot				Reduction Over Control (%)
			Pre count	1st Spray	2nd Spray	Mean	
T1	Tolfenpyrad 15 EC	1 ml	21.40	7.06	5.48	6.27	72.75
T2	Cyantraniliprole 10.26 OD	0.9 ml	23.06	5.70	3.10	4.40	81.38
T3	Imidacloprid 200 SL	0.3 ml	22.27	8.08	6.44	7.26	68.41
T4	Acetamiprid 20 SP	0.2 g	22.04	8.60	6.55	7.58	67.13
T5	Thiacloprid 240 SC	0.8 ml	21.49	7.21	5.37	6.29	72.75
T6	Fipronil 5 SC	2 ml	22.25	5.09	3.51	4.30	81.48
T7	Spirotetramat + Imidacloprid 240 SC	0.3 ml	22.49	4.93	3.06	3.99	82.93
T8	Untreated control	--	22.35	26.44	19.73	23.08	--

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