Research Article

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Anthranilicdiamide insecticide, Cyantraniliprole 10.26 OD for the control of pest complex in pomegranate

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ABSTRACT

The experiment was conducted to evaluate the bio-efficacy of a new anthranilic amide insecticide, Cyantraniliprole 10.26 OD, against aphids and thrips infesting pomegranate under the AICRP on Arid Zone Fruits at the Department of Horticulture, MPKV, Rahuri, during the *Ambe bahar* seasons from 2020-21 to 2022-23 on the Bhagwa variety of pomegranate. The four-year pooled data demonstrated that the application of Cyantraniliprole 10.26 OD at 0.75 to 0.9 ml per liter of water (75–90 g a.i./ha) was consistently effective in controlling aphids and thrips throughout the study period. The treatment resulted in significantly lower mean populations of aphids and thrips (2.1 to 6.18 and 1.74 to 3.65 per twig, respectively) compared to untreated control populations (24.9 and 14.47 per twig, respectively) on the 5th, 10th, and 15th days after two consecutive sprays. Cyantraniliprole 10.26 OD performed better than Lambda-cyhalothrin 5% EC, while Fipronil 5% EC and Spinosad 45 SC were the least effective treatments. Pooled yield and economic analysis revealed that Cyantraniliprole 10.26 OD at 0.9 ml per liter of water recorded the highest marketable fruit yield (15.26 t/ha) with a maximum cost-benefit ratio of 1:2.33 and an incremental cost-benefit ratio (ICBR) of 12.74. Based on these findings, it is recommended to apply two sprays of Cyantraniliprole 10.26 OD at 0.9 ml per liter of water at 15-day intervals during pest incidence for effective management of aphids and thrips on pomegranate.

Introduction

The pomegranate, *Punica granatum* L. belonging to family Punicaceae is a native of Iran and it is an ancient favorite table fruits of tropical and sub-tropical regions of the world. Pomegranate is rich in tannins and possess anti-atherosclerotic properties due to its potential anti-oxidative nature and also reduces blood pressure (Aviram and Dornfeld, 2001). India ranks first in area (2,57,000 ha), production (3097.72 MT) and productivity 12.01 MT/ha of pomegranate. Maharashtra state is leading state in country growing first in area(137.85 thousand ha), production (1554.25 thousand MT) and productivity 11.28 MT/ha (Anonymous, 2023).Future demand for export quality pomegranate may certainly show increasing trend.Such an important fruit crop is attacked by several insect and non-insect pests as well as diseases. About 91 insects, 6 mites and a snail pest found damaging pomegranate crop in India. The major pests observed during different fruiting season in pomegranate area are thrips (*Scirtthrips dorsalis* H.) and

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aphids (*Aphis punicae* P.) which cause serious damage by desapping and scaring the fruit rind that has resulted into threatened export quality of fruits. Moreover, the fruit borer (*Virachola isocrates* F.) recorded throughout the year in most part of India and causes 50 per cent loss in marketable yield (Balikai *et al.*, 2011). In past several insecticide have been proved effective and recommended for the pest control on pomegranate by university through State Agriculture recommendation committee. However, there was no specific label claim in pomegranate. Therefore, present investigation has been conducted tostudy the efficacy of novel additional chemistry of Anthranilicdiamide molecule, which is recently registered label claim under CIBRC for the control of pests of pomegranate as a sustainable approach in pest management.

Material and Methods

The present investigation was carried out during the year of 2020-21 to 2022-23 at experimental farm of AICRP on Arid Zone Fruits, Department of Horticulture, MPKV, Rahuri, Distt.-Ahmednagar (MS). The experiment was laid out in Randomized Block Design consisting seven treatments *viz*., Cyantraniliprole 10.26 OD at 0.7 & 0.9, Lambdacyhalothrin 5%EC at 0.5 & 1.0, Fipronil 5%SC at 1.0 and Spinosad 45 SC at 0.2 ml per litre of water including untreated control and each treatment replicated thrice on variety 'Bhagwa' of pomegranate (fours-year-old) with spacing of 4.5 x 3.0 m. For eachtreatment 4 L spray fluid was prepared by taking into account spray fluid @ 1000 Lha^{-1}. With hand operated knapsack sprayer equipped with hollow cone nozzle was used to carry out spray operation. Among total two spray withinterval at 15 days interval, first spray was taken at the flowering and fruit settingstage on incidence of the pest noticed.

The observations on pest's *viz.,* aphids and thrips was recorded at vegetative/ fruiting stage of the crop. The observations on survival population of aphid and thrips (both nymphs and adults) per five twig/ shoot were taken on 0 day as pre-count and 5th, 10th and 15th days after each spray as post count. Mean survival population of pest complex *i.e.* aphids and thrips (nymphs and adults) per twig was worked out in various treatments. The natural enemies (defenders: predators) were also recorded while taking the post count of the pests. The values of survival populations were subjected to statistical analysis by converting to angular transformed values (T) using formula, T= $\sqrt{n+0.5}$, where n = natural count of survived population of aphids and thrips. Fruit damage caused by borers was assessed at the time of harvest by categorizing fruits as healthy or infested. The percentage of damaged fruits was calculated and statistically analyzed using arc-sine transformation for normalization. The pomegranate fruit yield from each treatment was recorded per plant during each picking, conducted at 15-day intervals starting 150 days after the '*Bahar*' treatment and continuing until the conclusion of the harvesting period. The yield was measured in kilograms per plant and subsequently converted and expressed as tonnes per hectare. Additionally, economic data were analyzed, and the benefit-cost (B:C) ratio and incremental cost-benefit ratio (ICBR) were calculated to evaluate the profitability of each treatment.

Results and Discussion

Aphids (*Aphis punicae* P.): It is revealed from the three years pooled data presented in Table1 that the pre-count was found to be non-significant and recorded average survived aphids population in the range of 13.54 to 15.20 per twig. On 5th day, all the insecticide treatments were found effective against aphids as compared to untreated control. The treatment (T_2) Cyantraniliprole 10.26%OD @ 0.9 ml/litre was found most effective against aphids in recording least survival of aphids *i.e.* 4.10 per twig was found on par with the treatment of Fipronil 5%SC @ 1.0 ml/litre and recorded the average survived aphids in the range of 3.4 per twig as against 19.01 in untreated control. The next best promising treatment of Lambda-cyhalothrin 5% EC @ 1.0 per litre were also found effective against aphids. Significant difference were not noticed on 10th day after spray. The treatment of Cyantraniliprole 10.26%OD @ 0.9 ml litre of water, was found significantly effective and recorded least average survived aphids in the range of 1.92 as against 19.87 per twig in untreated control. The next best promising treatment of Cyantraniliprole 10.26%OD @ 0.75 ml was also found on par with the treatment dose of 0.9 ml per litre for the effective control of aphids. On 15th days after spray treatment, it was the evident that among the treatments the treatment of Cyantraniliprole 10.26%OD @ 0.9,0.75 ml, Lambda-cyhalothrin 5% EC @ 0.5 were found equally effective significantly superior over rest of the treatments and recorded least survival of aphids in the range of (2.78 to 4.27 per twig/shoot) as against 14.85 per twig in untreated control. However, the treatment of Cyantraniliprole 10.26%OD @ 0.9 ml per litre was found most effective treatment for the control of aphids.

Thrips (*Scirtothrips dorsalis* H.): It is revealed from the three years pooled data presented inTable1 that all the treatment were found effective for the control of thrips as against untreated control.The data on pre-count was found non-significant and recorded average survived thrips population in the range of 11.48 to 12.99 per twig /shoot.

Significant difference were not noticed on 5th day after spray. The data on 5th day observation presented in Table 2 revealed that, all the insecticide treatments were found effective against thrips as compared to untreated control. The treatment of Cyantraniliprole1 0.26%OD @ 0.9 ml/ litre was found most effective against thrips in registering average survival of aphids *i.e.* 4.90 per twig and on par with

the Cyantraniliprole 10.26%OD @ 0.75, Lambdacyhalothrin 5%EC @0.5 & 1.0, Fipronil @1.0 and Spinosad 2.5 SC @1.0 ml/litre of water and recorded least average survived population of thrips *i.e.* 6.60 to 7.43 per twigs as against 12.56 in untreated control. On 10th day after spray, the treatment of Cyantraniliprole10.26%OD @ 0.9 ml per litre found superior and recorded least average survivedthrips *i.e.*1.19 as against 19.70 /twig in untreated control. Which was found on par with Cyantraniliprole 10.26%OD @ 0.75 and Spinosad 0.25 ml per litre and recorded least survived thrip population *i.e.*1.3 &1.52 respectively for the control of thrips on pomegranate. On 15th days after spray, the treatment of Cyantraniliprole10.26% OD @ 0.9 ml per litre were found significantly superior for the control of thrip population and recorded average survived thrips*i.e.* 2.60 as against 6.6 per twig. However, the treatment of Cyantraniliprole10.26% OD @ 0.75ml, Lambda-cyhalothrin @ 1.0 and Spinosad 2.5 SC @1.0 ml/litre of water was found equally effective treatment for the control of thrips.

Anar butterfly (*Deudorix (=Virachola) Isocrates)*: The data on fruit borer damage revealed that, after last spray application, the treatment of Cyantraniliprole 10.26%OD @ 0.75 was found significantly effective in controlling fruit borer damage *i.e.* 3.28 per cent as against 16.32 in untreated control. The treatment of Lambda-cyhalothrin @ 1.0 ml/ litre found next best effective treatment for the control of fruit borer and recorded percent fruit damage due to Anar butterfly *i.e.* 5.24% as against (16.32%) untreated control. (Table 3)

Natural Enemies: As regards the influence of different treatments on natural enemies Lady birdbeelte (grubs) and pollinators, it was the evident that the natural enemies survival of coccinellids (LBB) was found in the range of 0.9 to 1.3 per 5 cm twigs/ plant as against 2.6 in untreated control. The pollinators (honey bees) survival after spray at 24 & 48 hrs, the treatments were found safe and effective in average surviving better population of pollinators (2.4 to 3.3 and 4.3 to 5.3 bees/ tree) as against 9.3 to 11.23 in control, respectively and found safe to these treatments at the time of flowering to fruiting stage on pomegranate (Table 3).

Marketable yield: All the insecticidal treatments exhibited good protection against pomegranate pests (Table 5). The treatment of Cyantraniliprole10.26% OD @ 0.9 ml/litre recorded significantly highest marketable yield of 19.68 kg/ plant (14.56 t/ha) followed by Lambda-cyhalothrin @ 1.0 ml/litre with 18.5 kg/plant (13.69 t/ha) as compared with the lowest yield was recorded in untreated control 14.60 kg/ plant (10.80 t/ha). It is revealed from the data presented on treatment economics and additional yield of pomegranate over untreated control and cost benefit ratio presented in Table 6 that the treatment of Cyantraniliprole 10.26% OD @ 0.9 ml/litre gave additional increase in yield (3.76 t/ha) with maximum cost benefit ratio and ICBR of 1:2.15 followed by with treatment Lambda-cyhalothrin @ 1.0 ml/litre (13.69 t/ha) with cost benefit ratio (1:2.07). Keeping in view to above results,it is recommended that the two sprays of Cyantraniliprole 10.26 OD @ 9 ml per 10 litre of water at an interval of 15 days is recommended for the control of aphids, and 0.75ml thrips and life for fruit borer in pomegranate as soon as incidence is noticed.

As regards the influence of different treatments on natural enemies Lady bird beelte (grubs) and pollinators, it was the evident that the natural enemies survival of coccinellids (LBB) was found in the range of 0.9 to 1.3 per 5 cm twigs/plant as against 2.6 in untreated control. The pollinators (honey bees) survival after spray at 24 & 48 hrs, the treatments were found safe and effective in average surviving better population of pollinators (2.4 to 3.3 and 4.3 to 5.3) as against 9.3 to 11.23 bees/tree in control, respectively and found safe to these biological treatments at the time of flowering to fruiting stage on pomegranate (Table 3)Several workers reported the organophosphate, Synthetic pyrethriods and neoniconoids as most effective for the control of sucking pests as well as lepidopteran borers of pomegranate. Earlier Balikai *et al.* (2011) and Walunj *et al.* (2015) reported effective control of thrips on pomegranate with Tolfenpyrad.

The observed findings are consistent with those of Anonymous (2020), who reported that two applications of Cyantraniliprole 10.2% OD at a dosage of 90 g a.i./ha were highly effective and recommended for the control of aphids and thrips infesting pomegranate. Patel *et al.* (2014) proved Cyantraniliprole @ 90-100 g a.i./ha for control of sucking pests on cotton. Patil *et al.* (2017) reported effective control of thrips in watermelon. Rath *et al.* (2013) showed effectiveness of Cyzpyre against stem borer and gall midge on rice, Savitha *et al.*(2018) and Kumar *et al.* (2019) showed effective control of thrips in watermelon.

Table 1. Efficacy of new molecules against aphids on pomegranate

S. No.	Treatment	Dose (ml/ litre water)	Pooled Mean on number of aphids (Nymphs and adults/ twig/ plant) (2020-21 to 2022-23)			
			Pre-Count	5 DAS	10 DAS	15 DAS
1.	Cyantraniliprole10.26OD	0.75	13.54 (3.75)	6.05 (2.44)	3.40 (1.76)	3.88 (1.92)

2.	Cyantraniliprole1 0.26OD	0.9	13.63 (3.71)	4.10 (1.97)	1.92 (1.40)	2.78 (1.64)
3.	Lambda-cyhalo-thrin 5 EC	0.5	14.37 (4.21)	7.16 (2.52)	5.79 (3.38)	5.07 (2.13)
4.	Lambda-cyhalo-thrin 5 EC	1.0	14.50 (4.22)	4.51 (2.21)	4.69 (5.16)	4.27 (2.08)
5.	Fipronil 5 SC	1.0	14.85 (4.17)	3.4 (1.97)	3.2 (2.15)	5.27 (2.23)
6.	Spinosad 45 SC	0.2	14.72 (3.97)	5.90 (2.73)	5.69 (2.65)	7.33 (2.89)
7.	Untreated control	-	15.20 (4.23)	19.01 (4.23)	19.87 (4.41)	14.85 (3.74)
	SEm+		0.185	0.26	1.47	0.36
	CD at 5%		NS	0.82	0.47	1.11
	CV (%)		5.7	17.6	31.1	25.96

Figures in parenthesis are transformed value √x+0.5

NS=Non-significant

Table 2. Efficacy of new molecules against thrips on pomegranate

S. No.	Treatment	Dose (ml/ litre water)	Pooled Mean on number of thrips (Nymphs and adults/ twig/ plant) (2020-21 to 2022-23)			
			Pre-Count	5 DAS	10 DAS	15 DAS
1.	Cyantraniliprole10.26OD	0.75	11.58 (3.24)	6.85 (2.66)	1.52 (1.52)	3.1 (1.85)
2.	Cyantraniliprole10.26OD	0.9	11.48 (3.17)	4.90 (2.25)	1.19 (1.19)	2.6 (1.51)
3.	Lambda-cyhalothrin 5 EC	0.5	11.89 (3.2)	6.60 (2.49)	1.93 (1.93)	4.3 (2.16)
4.	Lambda-cyhalothrin 5 EC	1.0	11.85 (3.28)	7.42 (2.56)	2.07 (2.07)	3.8 (2.16)
5.	Fipronil 5 SC	1.0	12.88 (3.29)	6.80 (2.62)	2.02 (2.02)	3.3 (2.32)
6.	Spinosad 45 SC	0.2	12.99 (3.46)	7.43 (2.47)	1.3 (1.5)	3.1 (1.7)
7.	Untreated control	-	12.12 (3.33)	12.56 (5.10)	19.7 (4.18)	6.6 (3.26)
	SEm+		0.10	0.29	0.23	0.28
	CD at 5%		NS	0.91	0.71	0.88
	CV (%)		5.4	17.63	19.34	22.73

Figures in parenthesis are transformed value √x+0.5

NS=Non-significant

Table 3. Effect of insecticide on activities of natural enemies on pomegranate

S. No.	Treatment	Dose (ml/litre water)	Pooled mean on survived natural enemies/ pollinators (bees)		
			Natural enemies LBB/ twig	Bees visit 24 hrs after spray	Bees visit 48 hrs after spray
1.	Cyantraniliprole10.26OD	0.75	2.0	2.3	4.0
2.	Cyantraniliprole10.26OD	0.9	1.3	2.0	3.3
3.	Lambda-cyhalothrin 5 EC	0.5	1.0	2.0	4.3
4.	Lambda-cyhalothrin 5 EC	1.0	0.6	1.6	2.9
5.	Fipronil 5 SC	1.0	2.0	3.6	4.6
6.	Spinosad 45 SC	0.2	2.3	3.0	4.3
7.	Untreated control	-	2.6	3.6	4.9

Table 4. Efficacy of treatments on per cent fruit borer damage on pomegranate

S. No.	Treatment	Dose		Pooled % fruit borer damage			Pooled Av. fruit damage (%)
		g a.i./ ha	ml / litre	2020-2021	2021-22	2022-23	
1.	Cyantraniliprole 10.26%OD	75	0.75	9.18 (17.60)	3.55 (10.85)	5.57 (13.67)	6.10 (14.23)
2.	Cyantraniliprole 10.26%OD	90	0.9	4.24 (9.73)	2.16 (8.32)	3.45 (10.65)	3.28 (9.03)
3.	Lambdacyhalothrin 5% EC	15	0.5	7.78 (16.20)	4.80 (12.66)	5.84 (14.11)	6.14 (14.43)
4.	Lambdacyhalothrin 5% EC	30	1.0	5.25 (10.77)	3.21 (10.32)	7.26 (15.62)	5.24 (10.547)
5.	Fipronil 5% SC	50	1.0	11.21 (19.4)	4.27 (11.88)	5.57 (13.54)	7.02 (15.64)
6.	Spinosad 45% SC	75	0.25	8.61 (17.1)	4.51 (12.23)	10.18 (18.61)	7.77 (14.67)
7.	Untreated control	-	-	18.31 (25.30)	12.21 (20.44)	18.43 (25.46)	16.32 (22.87)
SEm±				2.50	0.64	0.98	2.342
CD at 5%				7.73	1.98	3.03	0.752
CV 5%				26.21	8.99	10.69	8.988

Figures in parenthesis are arcsine transformed value

Table 5. Effect of treatments on yield of pomegranate

S. No.	Treatment	Dose		Three years pooled mean yield of pomegranate (kg/plant)			Pooled mean yield (kg/ plant)	Yield (t/ha)
		g a. i.	g/ ml/ litre	2020-21	2021-22	2022-23		
1.	Cyantraniliprole 10.26 %OD	75	0.75	19.27	17.17	18.00	18.15	13.43
2.	Cyantraniliprole 10.26 %OD	90	0.9	19.70	19.17	20.17	19.68	14.56
3.	Lambdacyhalothrin 5% EC	15	0.5	17.67	17.33	17.83	17.61	13.03
4.	Lambdacyhalothrin 5% EC	30	1.0	18.17	18.33	19.00	18.50	13.69
5.	Fipronil 5% SC	50	1.0	18.0	17.0	17.0	17.33	12.83
6.	Spinosad 45% SC	75	0.25	17.3	16.7	16.3	16.77	12.41
7.	Untreated control	-	-	14.4	14.5	14.9	14.60	10.80
	SEm±				0.47	0.49		0.21
	CD at 5 %				1.45	1.52		0.67

Table 6. Effect of treatments on economics on pomegranate

Treatment	Yield (t/ha)	Gross income (Rs/ ha)	Cost of insecticide treatment	Total expenditure (Rs/ ha)	Add. yield over control (t/ ha)	Net monetary return (Rs/ ha)	B:C ratio	ICBR
Cyantraniliprole 10.26%OD	13.43	671500	24525	333509	2.63	131500	5.36	2.01
Cyantraniliprole 10.26%OD	14.56	728000	28530	337514	3.76	188000	6.58	2.15
Lambdacyhalothrin 5% EC	13.03	651500	4500	313484	2.23	115000	2.55	2.07
Lambdacyhalothrin 5% EC	13.69	684500	9000	317984	2.89	144500	16.05	2.05
Fipronil 5% SC	12.83	641500	5253	314237	2.03	1.01500	19.32	2.04
Spinosad 45% SC	12.41	620500	18750	327734	1.61	80500	4.22	1.89
Untreated control	10.80	540000	-	-	-	-	-	-

* Total expenditure= Cost of cultivation Cost C (308984/-ha)
Cost of treatment = Cyantraniliprole @ Rs 8900/-litre (2250 ml* Rs 20025), Lambda-cyhalothrion @ Rs 1110/-litre, Fipronil @ Rs 502/-litre, Spinosad 45 SC @ Rs 18000/-litre
Cost of labour cost spraying Rs @ 300/- per day per labour (Rs 1500/- ha)

Market price rate of pomegranate fruit A grade @ 50000/ t.

Conclusion

Based on the four-year pooled data, it is concluded that the treatment Cyantraniliprole 10.26 OD at 0.75 to 0.9 ml/litre water (75- 90 g a.i./ha) showed equally effective for the control of aphids and thrips on variety Bhagwa of pomegranate. Spray of Cyantraniliprole 10.26 OD registered least survived pooled mean population of aphids and thrips *i.e.*2.1 to 6.18 and 1.74 to 3.65 as against 24.9 and 14.47 per twigs in untreated control respectively on 5th, 10th and 15th days after two consecutive sprays. This treatment also outperformed Lambda-cyhalothrin 5% EC. Therefore, it is recommended to apply two sprays of Cyantraniliprole 10.26 OD at a concentration of 0.9 ml per liter of water at 15-day

intervals during the *Ambe Bahar* season to effectively manage aphids and thrips in pomegranate.

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Conflict of Interest

The authors have no conflict of interest.

Data Sharing

All relevant data are within the manuscript.

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