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Bioefficacy of newer insecticides against anar butterfly, *Deodorex isocrates* Fab., on pomegranate

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Abstract
The present experiment was conducted to assess the Bioefficacy of newer insecticides against anar butterfly *Deodorex isocrates* Fab, on pomegranate at Horticulture research and Extension station, Vijayapur (Tidagundi), Karnataka for two years 2012 – 13 and 2014-15. Among different insecticides tested for the management of fruit borer significantly lower per cent fruit damage was recorded in chlorantraniliprole 18.5 SC @ 0.15 ml per liter over the years and highest marketable yield.

Keywords: Chlorantraniliprole, *Deodorex isocrates,* anar butterfly and pomegranate

1. Introduction
The pomegranate commonly called anar, dalim or dalimbe belongs to the family punicaceae [1]. It is one of the most adoptable subtropical fruit crops of the world. Pomegranate is native to Iran, where it was first cultivated around 2000 BC and spread to the Mediterranean countries [2]. It is extensively cultivated in Spain, Morocco, Egypt, Iran, Afghanistan, Arabia and Baluchistan [3]. Its cultivation spread further to other countries like China, Japan, USA, USSR, Pakistan and India, in India, during 1986[3]. The area under pomegranate cultivation increased owing to the introduction of high yielding soft seeded variety "Ganesh" in the states of Maharashtra, Karnataka and Gujarat [4]. Now in India it is being cultivated in Gujarat, Maharashtra, Karnataka, Uttar Pradesh, Andhra Pradesh and Tamil Nadu [5]. The literature related to the insect pests and mites incidence revealed that, there are 91 insects, 6 mites and 1 snail pest found feeding on pomegranate crop in India. The most obnoxious enemy is pomegranate (Anar butterfly) butterfly, *Deudorix* (=*Virachola*) isocrates Fab. which may destroy more than 50% of fruits. Next in the order are the three species of fruit sucking moths (*Eudocima* (=*Othreis*) *fullonia* (Clerk); *Eudocima* (=*Othreis*) *materna* (Linn.); *Eudocima* (=*Ot hreis*) *homaena* Hub.) and two species of bark eating caterpillars (*Indarbela tetraonis* (Moore); *Indarbela quadrinotata* (Walker) [6]. In the recent past two species of pomegranate shot hole borers (*Xyleborus fornicatus* E.; *X. perforans* Wollastan) have become major pests infesting in the collar region of the plant by making innumerable pin or shot holes causing discontinuity in the conducting vessels affecting conduction of water to the upper portion of the plant [6]. The most obnoxious Anar butterfly -*Deodorex Isocrates,* female butterfly lays eggs on flowers-buds and the calyx of developing fruits; in a few days the caterpillars enters the fruit and feed on the internal content of fruit [7]. The incidence of the pest is at its peak during the month of August during monsoon season, while in winter crop it is more during November/December [7]. Presently the fruit borers may cause loss of an entire crop unless the flowers are sprayed two times 30 days apart. There are no satisfactory control measures for the pest after it enters into the fruits [7]. Hence, the present investigations were carried out to find effective pesticide for the management of this pest.

2. Material and Methods
Field experiments were conducted for two years during the fruiting seasons (Hasta bahar) of 2013 and 2015 at the Horticulture research and extension station, Vijayapur (Tidagundi) in a 10 year old pomegranate orchard (Variety – Ganesh). The experiment was laid out in Randomized Block Design with seven treatment and three replications. The spray volume of 1000 liters per hectare was used. The spraying was done using knapsack sprayer fitted with hallow cone nozzle. The treatments were imposed after fruit set and uniform infestation of pest

in the experimental field. Totally three sprays were given at the interval of ten days. The observations on per cent fruit damage and marketable yield were recorded in all the treatments.

3. Results and Discussion

3.1 Efficacy of newer insecticides against Anar butterfly

3.1.1 First Season

The results on the experiment conducted on efficacy of newer insecticides against anar butter fly revealed that significantly less (17.56%) per cent damage of fruit by anar butterfly was recorded in chlorantraniliprole 18.5 SC 0.15 ml/l (T4) after seven days after spray followed by Emamectin benzoate 5 WG 0.2 g/l (T3), Spinosad 45 SC 0.25 ml/l (T2) and Indoxacarb 14.5 SC 0.30 ml/l (T1) (24.71, 24.78 and 24.17% respectively) (Table 1). However, Monocrotphos 36 SL 2.0 ml/l (T6) (31.40%) and NSKE 5% (T5) (32.38%) were found inferior to newer insecticides tested. The similar trend of superiority of chlorantraniliprole 18.5 SC @ 0.15 ml/l (T4) was recorded after ten days after first spray, second and third spray also. After third spray the mean per cent fruit damage ranged from 20.62 to 49.83 per cent among the treatments. The least fruit damage was recorded in chlorantraniliprole 18.5 SC @ 0.15 ml/l. Significantly highest marketable fruit yield was recorded in chlorantraniliprole 18.5 SC @ 0.15 ml/l (13.50 t/ha). The highest per cent increase (119.51%) in yield over untreated control was recorded in chlorantraniliprole 18.5 SC @ 0.15 ml/l (Table 3).

3.1.2 Second Season

The results on the experiment conducted on efficacy of newer insecticides against anar butter fly during second year revealed similar results of superiority of chlorantraniliprole 18.5 SC @ 0.15 ml/l. The results of the experiment conducted on efficacy of newer insecticides against anar butter fly revealed that significantly less (20.89) per cent damage of fruit by anar butterfly was recorded in chlorantraniliprole 18.5 SC @ 0.15 ml/l (T4) after seven days after spray followed by Emamectin benzoate 5 SG 0.2 g/l (T3), Spinosad 45 SC 0.25 ml/l (T2) and Indoxacarb 14.5 SC 0.30 ml/l (T1) (24.71, 24.78 and 25.50% respectively) (Table 2). However, Monocrotphos 36 SL 2.0 ml/l (T6) (32.07%) and NSKE 5% (T5) (30.71%) were found inferior to newer insecticides tested. The similar trend of superiority of chlorantraniliprole 18.5 SC @ 0.15 ml/l (T4) was recorded after ten days after first spray, second and third spray also. After third spray the mean per cent fruit damage ranged from 23.12 to 42.81 per cent among the treatments. The least fruit damage was recorded in chlorantraniliprole 18.5 SC @ 0.15 ml/l. Significantly highest marketable fruit yield was recorded in chlorantraniliprole 18.5 SC @ 0.15 ml/l (13.98 t/ha). The highest per cent increase (127.32%) in yield over untreated control was recorded in chlorantraniliprole 18.5 SC @ 0.15 ml/l (Table 3).

The superiority of chlorantraniliprole in the management of anar butterfly may be due to the novel mode of action of anthranilic daiamide i.e., chlorantraniliprole. This insecticide potentially activates ryanodine receptors, releasing stored calcium from the sacro- endolplasmic reticulum leading to impaired regulation of muscle contraction [8]. Similar results of superiority of anthranilic diamide, cyantraniliprole was recorded in the management of pests of grapes [9]. The efficacy of chlorantraniliprole was proved in many crops towards management of noxious lepiodperan pests in many field and horticultural crops [10-12].

Table 1: Per cent fruit damage by fruit borer in pomegranate during 2012-13

Sl. No	Treatment	Per cent fruit damage									
		I Spray				II Spray			III Spray		
		Before spray	7 DAS	10 DAS	Mean	7 DAS	10 DAS	Mean	7 DAS	10 DAS	Mean
T1	Indoxacarb 14.5 SC 0.30 ml/l	15.86 (23.41)	24.17 (29.41)	24.88 (29.84)	24.53	26.82 (31.14)	28.40 (32.15)	27.61	30.19 (33.30)	30.84 (33.70)	30.52
T2	Spinosad 45 SC 0.25 ml/l	16.81 (24.15)	24.78 (29.83)	25.29 (30.19)	25.03	26.42 (30.90)	27.67 (31.70)	27.04	29.68 (32.90)	29.99 (33.18)	29.84
T3	Emamectin benzoate 5 SG 0.2 g/l	16.41 (23.83)	24.71 (29.80)	25.01 (29.93)	24.86	26.36 (30.86)	28.93 (32.52)	27.65	29.61 (32.92)	31.26 (33.95)	30.44
T4	Chlorantraniliprole 18.5 SC 0.15 ml /l	17.25 (24.43)	17.56 (24.64)	17.64 (24.80)	17.60	18.21 (25.22)	19.75 (26.23)	18.98	20.13 (26.58)	21.11 (27.25)	20.62
T5	NSKE 5%	18.41 (25.41)	32.38 (34.67)	33.62 (35.43)	33.00	34.70 (36.08)	36.93 (37.42)	35.82	38.28 (38.22)	40.34 (39.43)	39.31
T6	POP (Monocrotphos 36 SL 2.0 ml/l)	19.09 (25.90)	31.40 (34.07)	35.64 (36.65)	33.52	34.71 (36.10)	39.29 (38.81)	37.00	39.63 (39.01)	38.95 (38.62)	39.29
T7	UTC	22.11 (28.03)	39.11 (38.71)	43.02 (40.98)	41.07	43.23 (41.09)	47.28 (43.43)	45.26	48.93 (44.39)	50.74 (45.42)	49.83
	SEm±	NS	1.19	1.25		1.16	1.33		1.36	1.46	
	CD (@5%)	NS	3.65	3.86		3.56	4.12		4.19	4.50	
	CV %	NS	6.50	6.65		6.04	6.62		6.66	7.03	

UTC – Untreated Control DAS – Days after Spray POP – Package of Practice

Table 2: Per cent fruit damage by fruit borer during 2015-16

Sl. No	Treatment	Per cent fruit damage									
		I Spray				II Spray			III Spray		
		Before spray	7 DAS	10 DAS	Mean	7 DAS	10 DAS	Mean	7 DAS	10 DAS	Mean
T1	Indoxacarb 14.5 SC 0.30 ml/l	18.61 (25.47)	25.50 (30.28)	28.75 (32.38)	27.12	29.15 (32.64)	32.40 (34.66)	30.78	30.19 (33.30)	31.51 (34.11)	30.85
T2	Spinosad 45 SC 0.25 ml/l	19.56 (26.21)	24.78 (29.82)	28.35 (32.15)	26.57	28.43 (32.20)	32.00 (34.43)	30.22	29.68 (32.99)	32.00 (34.43)	30.84
T3	Emamectin benzoate 5 SG 0.2 g/l	19.16 (25.90)	24.71 (29.74)	28.28 (32.08)	26.50	28.36 (32.13)	31.93 (34.37)	30.15	29.61 (32.92)	31.26 (33.95)	30.44
T4	Chlorantraniliprole 18.5 SC 0.15 ml /l	20.00 (26.48)	20.89 (27.13)	24.46 (29.59)	22.68	24.54 (29.65)	28.11 (31.98)	26.33	22.13 (27.99)	24.11 (29.33)	23.12
T5	NSKE 5%	21.16 (27.38)	30.71 (33.65)	33.28 (35.23)	32.00	34.36 (35.88)	36.93 (37.42)	35.65	35.61 (36.63)	37.26 (37.62)	36.44
T6	POP (Monocrotphos 36 SL 2.0 ml/l)	21.84 (27.86)	32.07 (34.49)	35.64 (36.65)	33.85	35.72 (36.70)	39.29 (38.81)	37.51	36.97 (37.44)	38.62 (38.42)	37.80
T7	UTC	22.11 (28.03)	36.45 (37.13)	40.02 (39.24)	38.23	40.10 (39.28)	45.32 (42.31)	42.71	41.98 (40.38)	43.63 (41.34)	42.81
	SEm±		1.19	1.17		1.14	1.21		1.32	1.36	
	CD (@5%)		3.68	3.61		3.51	3.73		4.06	4.20	
	CV %		6.52	5.98		5.80	5.78		6.61	6.64	

UTC – Untreated Control DAS – Days after Spray POP – Package of Practice

Table 3: Yield of pomegranate and Per cent increase of yield over Untreated Control

Sl. No	Treatment	2012-13		2015-16	
		Marketable yield (t/ha)	Per cent increase of yield over UTC	Marketable yield (t/ha)	Per cent increase of yield over UTC
T1	Indoxacarb 14.5 SC 0.30 ml/l	10.87	76.75	11.36	84.72
T2	Spinosad 45 SC 0.25 ml/l	11.20	82.11	11.68	89.92
T3	Emamectin benzoate 5 SG 0.2 g/l	11.27	83.25	11.76	91.22
T4	Chlorantraniliprole 18.5 SC 0.15 ml /l	13.50	119.51	13.98	127.32
T5	NSKE 5%	8.18	33.01	8.67	40.98
T6	POP (Monocrotphos 36 SL 2.0 ml/l)	8.50	38.21	8.98	46.02
T7	UTC	6.15	--	6.63	--
	SEm±	0.41		0.41	
	CD (@5%)	1.27		1.27	
	CV %	7.16		6.82	

UTC – Untreated Control DAS – Days after Spray POP – Package of Practice

4. Conclusion

The new generation insecticide, chlorantraniliprole 18.5 SC @ 0.15 ml/l can be recommended for effective management of anar butterfly in pomegranate.

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