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Management of pomegranate fruit borer, *Deudorix isocrate* F. under Marathwada condition

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Abstract
The field experiment on management of pomegranate fruit borer, *Deudorix isocrate* conducted during Hasta bahar 2016 and 2017 on number and weight basis at the Pomology Research Farm, Department of Horticulture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (Maharashtra). The results revealed that all the treatments were superior over control in minimizing infestation of fruit borer. The lowest % fruit infestation on number and weight basis was observed in spinosad 45 SC @ 73 g a.i./ha, chlorantraniliprole 18.5 SC @ 30 g a.i./ha and flubendamide 39.35 SC which were statistically superior over other treatments. Next superior treatments were cyantraniliprole 10.26 OD @ 75 g a.i./ha and emamectin benzoate 5 SG @ 11 g a.i./ha. Maximum fruit infestation was recorded in untreated control.

Keywords: Management, pomegranate, hasta bahar, *Deudorix isocrate*, number basis, weight basis, spinosad, chlorantraniliprole, flubendamide

1. Introduction
Pomegranate (*Punica granatum* L.) is one of the most commercial subtropical fruit crop belongs to one of the smallest families of plant kingdom, Punicaceae [5]. Pomegranate cultivation is unique in its own way because of its drought tolerant hardy nature, low maintenance cost, steady and good yields, fine table and therapeutic values, better keeping quality and possibilities of throwing the plant into rest during period when irrigation potential is low, particularly in the hot, semi-arid and desert regions of Maharashtra, Uttar Pradesh, Andhra Pradesh, Gujarat, Karnataka and Tamil Nadu where its cultivation has spread extensively. In India, it is cultivated on 208.73 thousand ha area with a production of 2442.39 thousand MT and the productivity is 11.70 MT per ha. Maharashtra ranks first in area 136.75 thousand ha with a production of 1578.04 thousand MT and productivity of 11.54 MT per ha [1]. Through scanning of literature revealed a total of 91 insects, 6 mites and 1 snail pest feeding on pomegranate crop in India. The most obnoxious enemy is pomegranate butterfly, *Deudorix* (*Virachola*) *isocrates* (Fabricius) which may destroy more than 50 per cent of fruits [3]. Pomegranate fruit borer, *D. isocrates* is one the most destructive insect pest incurring about 65 to 70% of yield loss worldwide [9]. *D.* (*Virachola*) *isocrates* F. which may cause more than 50% fruits of pomegranate [2]. The incidence of fruit borer has been reported throughout the year with varying degrees of intensity in Maharashtra and Karnataka [13]. The average losses due to pomegranate fruit borer is 40 to 90% have been reported in India [14]. 100% fruit damage of pomegranate under severe endemic conditions in Karnataka [7]. To overcome resistance problems, reduce doses of insecticides with selective mode of action and persistence against target pest. The present study on management of pomegranate fruit borer on number and weight basis during Hasta bahar.

2. Materials and Methods
The field experiment was conducted during Hasta bahar 2016 and 2017 on management of pomegranate fruit borer on number and weight basis at Pomology Research Farm, Department of Horticulture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (Maharashtra) in a randomized block design with three replication and seven chemical treatments with untreated control. Bhagwa variety was used with spacing 4 m x 4 m. The observations were recorded on total number of healthy and infested fruits to calculate % infested fruits at one day before, 7

and 14 days after application of insecticides from two selected plants of each treatment of each replication. All the infested fruits from selected plants were marked using a tag tied around the shoot to avoid recounting during the next observation. % fruit infestation was calculated by using the following formula: % fruit infestation = (Number of infested fruits/Total number of fruits) x 100. The weight of total fruits harvested and infested from two plants of each treatment of each replication were taken into account to calculate % infestation of fruits on weight basis by using the following formula: % fruit infestation = (Weight of infested fruits/Weight of total fruits) x 100.

The mean data on efficacy and yield were statistically analyzed and subjected to the analysis of variance by adopting the appropriate methods as outlined by [12] and [6] by adopting "Fishers analysis of variance technique".

Table 1: Details of insecticides used in experiment

Tr. No.	Treatments	Concentration (%)	Active ingredients (g a.i./ha)	Dose (ml or g/ha)
1.	Chlorantraniliprole 18.5% SC	0.006	30	150
2.	Emamectin benzoate 5% SG	0.002	11	220
3.	Flubendamide 39.35% SC	0.008	48	100
4.	Novaluron 10% EC	0.02	100	1000
5.	Spinosad 45% SC	0.014	73	160
6.	Cyantraniliprole 10.26% OD	0.015	75	750
7.	Lambda cyhalothrin 5% EC	0.003	15	300
8.	Untreated control	-	-	-

3. Results and Discussion

3.1 Management of pomegranate fruit borer (Number basis)

The data in respect to management of pomegranate fruit borer during Hasta bahar 2016, average of 7 and 14 days based on number basis after first, second and third spray are presented in the Table 2. After 1st spray, it was observed that the lowest mean per cent of fruit infestation was observed in spinosad 45 SC (4.12%) which was at par with chlorantraniliprole 18.5 SC (4.89%). The next best treatments were flubendamide 39.35 SC (5.58%) and cyantraniliprole 10.26 OD (6.29%). After 2nd spray, minimum per cent of fruit infestation was observed in spinosad 45 SC (2.55%) and it was at par with chlorantraniliprole 18.5 SC (3.93%). After 3rd spray, minimum fruit infestation was observed in spinosad 45 SC (1.63%) and it was at par with chlorantraniliprole 18.5 SC (2.04%) and flubendamide 39.35 SC (3.25%). The next promising treatments were cyantraniliprole 10.26 OD (4.40%) and emamectin benzoate 5 SG (5.52%). The treatment lambda cyhalothrin (7.95%) and novaluron (9.50%) recorded higher fruit infestation but significantly less than untreated control (36.72%).

The fruit borer infestation recorded before spray was ranged between 10.66 to 14.73 per cent, showing slow increase in live count of fruit borer during Hasta bahar 2017 (Table 2). After 1st spray the lowest per cent of fruit infestation was observed in spinosad 45 SC (3.40%) which was at par with chlorantraniliprole 18.5 SC (3.87%). The next better treatments were flubendamide 39.35 SC (4.98%) and cyantraniliprole 10.26 OD (5.90%). After 2nd spray, minimum per cent fruit infestation was observed in spinosad 45 SC (1.86%) followed by chlorantraniliprole (2.15) and flubendamide 39.35 SC (3.11%) which were at par with each other. The next best treatments were cyantraniliprole 10.26 OD (4.18%) and emamectin benzoate 5 SG (5.87%). Lambda cyhalothrin and novaluron recorded highest infestation of fruits but it was significantly superior over untreated control. Similar trend of results was observed after 3rd spray and the order of efficacy was spinosad (1.00%) followed by chlorantraniliprole (1.24%), flubendamide (1.99%), cyantraniliprole (3.04%), emamectin benzoate (4.08), lambda cyhalothrin (8.19%), novaluron (9.82).

The pooled data of management of pomegranate fruit borer during Hasta bahar 2016 and 2017 on number basis are presented in the Table 3 and graphically depicted in Fig. 01. The fruit borer infestation on number basis recorded before spray was ranged between 10.02 to 14.72 per cent. All insecticidal treatments were significantly superior over untreated control in minimizing the pest incidence. After 1st and 2nd spray, it was revealed that minimum fruit infestation was observed in spinosad 45 SC (3.76 and 2.20%) which was at par with chlorantraniliprole 18.5 SC (4.38 and 3.04%). The infestation in control was increased from 25.61 to 37.63 per cent during 1st to 3rd spray. Rest of the insecticidal treatments recorded 5.26 to 12.24 and 3.84 to 11.57 per cent fruit infestation at 1st and 2nd sprays, respectively. After 3rd spray, minimum fruit infestation was observed in spinosad 45 SC (1.31%) followed by chlorantraniliprole 18.5 SC (1.64%) and flubendamide 39.35 SC (2.62%) which were at par with each other. Next superior treatments were cyantraniliprole and emamectin benzoate (3.72 and 4.80%). Maximum fruit infestation was recorded in untreated control (37.63%).

The results of present investigation are in accordance with earlier scientist, the plants treated with spinosad 75 g a.i./ha recorded the lowest per cent fruit infestation of pomegranate fruit borer. It was followed by indoxacarb 75 g a.i./ha and chlorantraniliprole 30 g a.i./ha which were at par with each other [4]. Significantly lower per cent fruit damage was recorded in chlorantraniliprole 18.5 SC @ 0.15 ml/L [11]. The per cent fruit infestation on number basis was significantly lowest in chlorantraniliprole and spinosad treated plots as compared to other treatments [10]. Emamectin benzoate 5 SG @ 0.25 g/ l ha recorded highest reduction in pomegranate fruit damage at 3, 7 and 14 days followed by spinosad 45 SC @ 0.20 ml/l [8].

3.2 Management of pomegranate fruit borer (Weight basis)

The data recorded during Hasta bahar 2016 on per cent fruit infestation due to *D. isocrates* after 3rd spray, the lowest mean per cent fruit infestation was observed in spinosad 45 SC (1.11%), chlorantraniliprole 18.5 SC (1.22%), flubendamide 39.35 SC (1.73%) and cyantraniliprole 10.26 OD (2.75%) which were at par with each other. The observations recorded during Hasta bahar 2017 on per cent fruit infestation due to *D. isocrates* after 3rd spray clearly indicated that lowest mean per cent fruit infestation was observed in spinosad 45 SC (1.15%) followed by chlorantraniliprole 18.5 SC (1.17%) and flubendamide 39.35 SC (1.66%) which were at par with each other.

The pooled data of mean percentage of infested fruits after third spray are given in Table 4 and graphically depicted in Fig. 02. It indicated that the treatment spinosad 45 SC was found highly effective over all treatments and recorded the least damaged fruits (1.13%) followed by chlorantraniliprole 18.5 SC (1.19%) and flubendamide 39.35 SC (1.70%) which were at par with each other. The subsequent treatments were cyantraniliprole 10.26 OD (2.52%), emamectin benzoate 5 SG (3.42%), lambda cyhalothrin 5 EC (6.91%) and novaluran 10 EC (8.83%). The maximum mean per cent fruit infestation was recorded in untreated plants (32.56%) during Hasta bahar 2016 and 2017.

These findings are in accordance with the results represented by earlier scientist, stated that per cent fruit infestation on weight basis was significantly lowest in chlorantraniliprole (6.31%) and spinosad (11.15%) treated plots as compared to other treatments [10].

Table 2: Management of pomegranate fruit borer in Hasta bahar 2016 and 2017 (Number basis)

Tr. No.	Treatment	Conc. (%)	Pre-count	% infested fruits (Av. of 7 and 14 DAS) 2016			% infested fruits (Av. of 7 and 14 DAS) 2017			
				First spray	Second spray	Third spray	Pre- count	First spray	Second spray	Third spray
T_1	Chlorantraniliprole 18.5 SC	0.006	10.18 (18.58)*	4.89 (12.77)	3.93 (11.41)	2.04 (8.16)	12.11 (20.29)*	3.87 (11.27)	2.15 (8.41)	1.24 (6.23)
T_2	Emamectin benzoate 5 SG	0.002	11.08 (19.37)	7.72 (16.07)	6.68 (14.90)	5.52 (13.40)	12.08 (20.06)	7.19 (15.55)	5.87 (13.86)	4.08 (11.45)
T_3	Flubendamide 39.35 SC	0.008	9.88 (18.26)	5.58 (13.66)	4.58 (12.26)	3.25 (10.36)	10.16 (18.54)	4.98 (12.88)	3.11 (10.01)	1.99 (8.01)
T_4	Novaluron 10 EC	0.02	14.91 (22.62)	12.63 (20.81)	12.04 (20.30)	9.50 (17.86)	14.20 (22.12)	11.86 (20.13)	11.10 (19.46)	9.82 (18.24)
T_5	Spinosad 45 SC	0.014	10.45 (18.85)	4.12 (11.68)	2.55 (9.11)	1.63 (7.30)	14.68 (22.13)	3.40 (10.59)	1.86 (7.70)	1.00 (5.54)
T_6	Cyantraniliprole 10.26 OD	0.015	10.49 (18.83)	6.29 (14.50)	5.52 (13.55)	4.40 (11.97)	10.66 (19.01)	5.90 (14.02)	4.18 (11.74)	3.04 (9.97)
T_7	Lambda cyhalothrin 5 EC	0.003	13.81 (21.75)	11.06 (19.42)	10.52 (18.93)	7.95 (16.28)	13.50 (21.46)	10.48 (18.87)	9.14 (17.59)	8.19 (16.63)
T_8	Untreated control	-	14.70 (21.81)	25.83 (30.55)	29.47 (32.88)	36.72 (37.29)	14.73 (22.27)	25.38 (30.25)	32.24 (34.59)	38.55 (38.38)
S.E. ±			2.02	0.58	0.77	1.14	2.13	0.64	0.92	0.97
C.D. at 5%			NS	1.75	2.34	3.46	NS	1.95	2.80	2.93

DAS= Days after spray *Figures in parentheses are arc sin transformed values

Table 3: Management of pomegranate fruit borer (Pooled data of Hasta bahar 2016 and 2017) (Number basis)

Tr. No.	Treatment	Conc. (%)	Pre- count	Per cent infested fruits (Av. of 7 and 14 DAS)		
				First spray	Second spray	Third spray
T_1	Chlorantraniliprole 18.5 SC	0.006	11.14 (19.46)*	4.38 (12.05)	3.04 (10.02)	1.64 (7.27)
T_2	Emamectin benzoate 5 SG	0.002	11.58 (19.74)	7.46 (15.82)	6.27 (14.39)	4.80 (12.46)
T_3	Flubendamide 39.35 SC	0.008	10.02 (18.41)	5.28 (13.28)	3.84 (11.20)	2.62 (9.27)
T_4	Novaluron 10 EC	0.02	14.55 (22.38)	12.24 (20.47)	11.57 (19.88)	9.66 (18.05)
T_5	Spinosad 45 SC	0.014	12.56 (20.61)	3.76 (11.15)	2.20 (8.44)	1.31 (6.50)
T_6	Cyantraniliprole 10.26 OD	0.015	10.57 (18.92)	6.09 (14.26)	4.85 (12.68)	3.72 (11.02)
T_7	Lambda cyhalothrin 5 EC	0.003	13.66 (21.60)	10.77 (19.15)	9.83 (18.27)	8.07 (16.49)
T_8	Untreated control	-	14.72 (22.07)	25.61 (30.40)	30.86 (33.74)	37.63 (37.84)
S.E. ±			2.00	0.57	0.83	0.97
C.D. at 5%			NS	1.73	2.51	2.94

DAS= Days after spray *Figures in parentheses are arc sin transformed values

Table 4: Management of pomegranate fruit borer (Weight basis)

Tr. No.	Treatment	Conc. (%)	% infested fruits (After 3rd spray)		
			Hasta bahar 2016	Hasta bahar 2017	Pooled
T_1	Chlorantraniliprole 18.5 SC	0.006	1.22 (6.31)	1.17 (6.17)	1.19 (6.25)
T_2	Emamectin benzoate 5 SG	0.002	3.71 (11.06)	3.12 (10.09)	3.42 (10.65)
T_3	Flubendamide 39.35 SC	0.008	1.73 (7.55)	1.66 (7.31)	1.70 (7.46)
T_4	Novaluron 10 EC	0.02	8.54 (16.98)	9.11 (17.54)	8.83 (17.28)
T_5	Spinosad 45 SC	0.014	1.11 (6.04)	1.15 (6.14)	1.13 (6.10)
T_6	Cyantraniliprole 10.26 OD	0.015	2.75 (9.00)	2.28 (8.67)	2.52 (8.95)
T_7	Lambda cyhalothrin 5 EC	0.003	6.63 (14.90)	7.18 (15.51)	6.91 (15.21)
T_8	Untreated control	-	31.87 (34.37)	33.24 (35.20)	32.56 (34.79)
S.E. ±			0.97	0.71	0.58
C.D. at 5%			2.95	2.17	1.77

*Figures in parentheses are arc sin transformed values

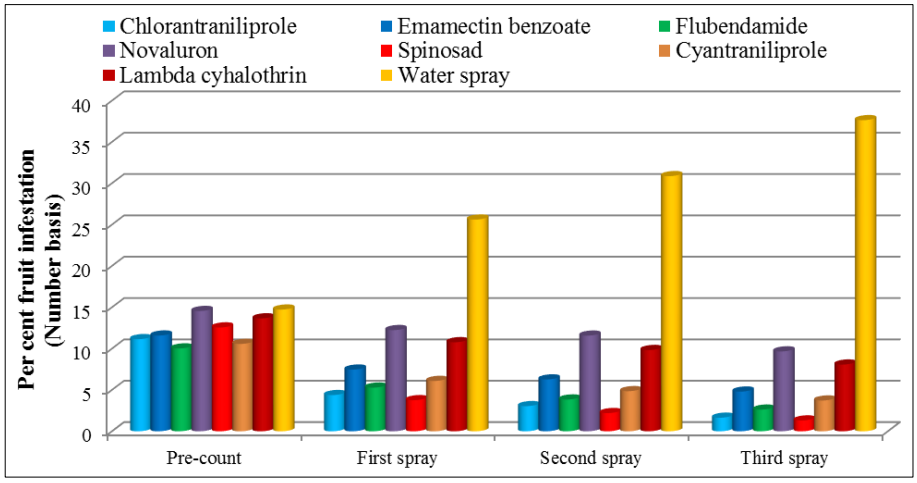

Fig 1: Management of pomegranate fruit borer (Pooled data of Hasta bahar 2016 and 2017) (Number basis)

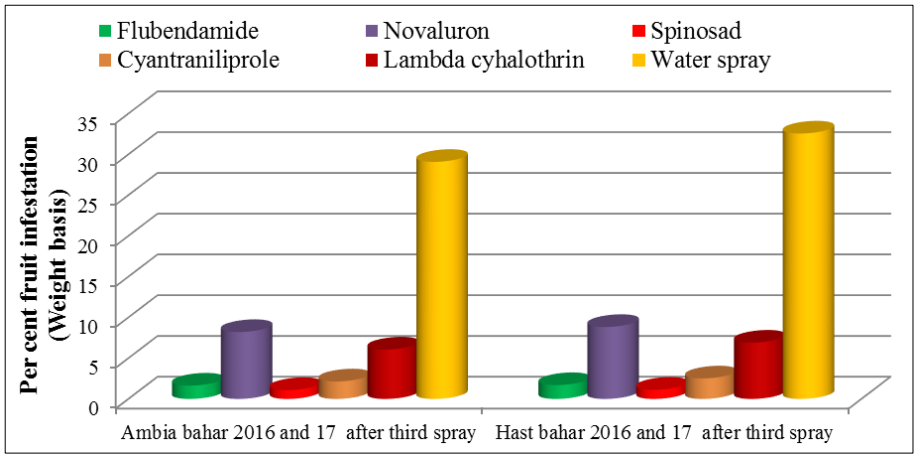

Fig 2: Management of pomegranate fruit borer (Pooled data of Ambia bahar 2016 and 2017 and Hasta bahar 2016 and 2017) (Weight basis)

4. Conclusion

Concluded that among the insecticides spinosad 45 SC was most effective insecticide against pomegranate fruit borer followed by chlorantraniliprole 18.5 SC and flubendamide 39.35 SC.

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