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Efficacy of combination product flubendiamide 240+ thiacloprid 240 (Belt expert 480SC) against chilli fruit borers

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Abstract
A field experiment was conducted at AICRP on Vegetables, Mahatma Phule Krishi Vidyapeeth, Rahuri (M.S.) during rabi-2017 to test the bioefficacy of a new combiproduct, flubendiamide 240+ thiacloprid 240 (Belt Expert 480SC) against chilli fruit borers, *Helicoverpa armigera* (Hubner) and *Spodoptera* spp. The results indicated that among various treatments, flubendiamide 240+ thiacloprid 240 @ 120 g a.i./ha was found superior treatment with least larval population of *Helicoverpa armigera* (0.13 larvae per plant), *Spodoptera* spp. (0.33 larvae per meter row length) and least fruit damage (1.73%). It was however at par with chlorantraniliprole 20SC @ 30 g a.i./ha and followed by flubendiamide 480SC @ 60 g a.i./ha. Belt Expert @ 120 g a.i. /ha also recorded highest yield (229.40 q/ha) and was cost effective (B:C ratio of 7.54) followed by Coragen 20SC @ 30 g a.i./ha (222.53 q/ha) and Fame 480SC @ 60 g a.i./ha (216.67 q/ha).

Keywords: Chilli, fruit borers, belt expert, chlorantraniliprole, flubendiamide

1. Introduction
Chilli (*Capsicum annuum* Linn.) is the most important universal spice-cum-vegetable crop which belongs to the family solanaceae and originated from Mexico [2]. It is widely cultivated for use as spice or vegetable in temperate and tropical countries. It is also known as red pepper [2]. Chilli fruit is mainly used as green or dried to impart pungency to food. Dried red chilli powder is used as a condiment for preparation of vegetable and it is rich in vitamin ‘A’ and ‘C’ [5]. The chilli seeds contain traces of starch, which are used as ingredient of certain medicines. It has medicinal significance in dyspepsia and prevents blood cancer [5]. Oleoresins and essential oils of chillies are active constituents for providing characteristic pungency, flavour, aroma, and have number of uses in capsaicin industries as well as in meat seasoning and other food industries [2].

In India, the crop is grown as cash crop over an area of 1.81 lakh ha, with a production of 19.9 lakh MT and the productivity of 11 MT/ha [4]. Andhra Pradesh, Telangana, Karnataka, Tamil Nadu and Maharashtra are the major chilli producing state in the country. In Maharashtra, the crop is mainly grown in Nagpur, Chandrapur, Dhule, Nanded, Pune, Kolhapur and Amaravati districts over an area of 12,300 ha, with a productivity of 10.4 MT/ha [3].

A number of limiting factors have been attributed for low productivity in chilli. Among them ravages caused by insect pests are significant [15]. The pest spectrum of chilli crop is complex with more than 293 insects and mite species debilitating the crop in the field as well as in storage [2]. Among different insect pests, fruit borers *viz.*, *Helicoverpa and Spodoptera*, are known to attack crop in most severe form. The damage caused by *Helicoverpa armigera* (Hubner) and *Spodoptera litura* (Fb.) during flowering and fruit formation is the great concern. Katagihallimath [9] reported complete destruction of the fruit contents by *H. armigera* larvae in chilli, which infested up to 92 percent of the plants and caused 77 percent fruit damage. As reported by Reddy and Reddy [13] due to severe attack of fruit borers lead to 90 percent flower and fruit drop in chilli. Many conventional insecticides are being used to manage these pests. But because of development of many fold resistance to existing insecticides, it has become difficult to manage the fruit borers. There is a need to replace ineffective ones with effective insecticides. Hence, the present study was undertaken to find out the efficacy of new combiproduct, flubendiamide 240+ thiacloprid 240 (Belt Expert 480SC) for the management of fruit borers.

2. Materials and Methods

The present experiment was conducted at AICRP on Vegetables, Mahatma Phule Krishi Vidyapeeth, Rahuri (M.S.) during *rabi*-2017. The crop (chilli var. *Phule Jyothi*) was raised as per university standard package of practices except plant protection measures with a plot size of 5 × 5 m^2. The soil type was medium black and the crop was grown with irrigation. Experiment was laid in randomized block design with eight treatments replicated thrice.

The treatments included, Belt Expert 480 SC (flubendiamide 240+ thiacloprid 240 – 480 SC) @ 120 g a.i. ha^{-1}, Fame 480 SC (flubendiamide 480 SC) @ 60 g a.i. ha^{-1}, Bio-Magic (*Metarhizium anisopliae* - 1x10^9 cfu's/ml) @ 3 L ha^{-1}, Bio-Power (*Beauveria bassiana* -1x10^9 cfu's/ml) @ 3 L ha^{-1}, Bio-Catch (*Verticillium lecanii* - 1x10^9 cfu's/ml) @ 3 L ha^{-1}, Coragen 20 SC (chlorantraniliprole) @ 30 g a.i. ha^{-1}, Dursban 20EC (chlorpyrifos – Farmer's practice) @ 200 g a.i. ha^{-1} and untreated control. Two sprays were carried out, first being when pest reached ETL (*Helicoverpa* – 1 larva/plant; *Spodoptera* – 2 larvae/ mrl; 5% fruit damage) and second at 15 day interval. The spray solution was prepared by mixing the required quantity of chemical (per litre of water basis) in water (400 L of spray fluid per ha) and applied using high volume knapsack sprayer (15 L capacity).

Data was recorded on the population separately for each insect pest (Interval: before and 3, 7, 10 and 14 days after application). For *Helicoverpa armigera*, larval count was recorded from 5 randomly selected plants per plot. For *Spodoptera* spp., larval count was recorded per metre row length (mrl). Total and damaged fruits were also recorded at 7 and 14 days after each spray. The damage percentage was calculated by using the following formula [8],

$$\text{Percent fruit damage} = \frac{\text{Number of fruits damaged}}{\text{Total number of fruits}} \text{ X } 100$$

Green chillies were harvested from entire plot separately and yield per plot was recorded during each picking. Total yield was calculated by adding the yield of each picking. The per plot yield was then converted to q per ha. The incremental cost benefit ratio was calculated to assess the cost effectiveness of the treatment.

2. Statistical analysis

The observations recorded were subjected to statistical analysis (RBD) to know the significance of difference among different treatments. The values in percentages were transformed to angular values and values in number were transformed into square root values before analysis [6].

3. Results and Discussions

a. Effect on *H. armigera*

The results of experiment indicated that, before taking up spray there was no significant difference among the treatments and the population of *Helicoverpa* ranged from 1.67 to 1.93 larvae per plant (Table 1). At three days after the first spray, there was reduction in the number of larvae per plant which ranged from 0.53 to 1.73 per plant and all the treatments were significantly lower than that in untreated control. The plots treated with chlorantraniliprole 20SC @ 30 g a.i./ha recorded least number of larvae (0.53/plant) which was at par with Belt Expert 480SC @ 120 g a.i./ha (0.60/plant), followed by flubendiamide 480SC @ 60 g a.i./ha (0.67 /plant). Almost a similar trend of effectiveness of chemicals was observed at 7 DAS. At 10 DAS, the plots treated with chlorantraniliprole 20SC @ 30 g a.i./ha recorded least number of larvae (0.13/plant) which was equally good with Belt Expert 480SC @ 120 g a.i./ha (0.20/plant), followed by flubendiamide 480SC @ 60 g a.i./ha (0.27 /plant). Next in order of effectiveness were chlorpyrifos (0.87/plant), *M. anisopliae* (1.23/plant), *B. bassiana* (1.30/plant) and *V. lecanii* (1.37/plant), respectively.

The data also revealed that the population of *Helicoverpa* after second spray ranged from 0.47 to 1.73 larvae per plant (Table 1). The population declined from 3 to 10 DAS and increased marginally at 14 DAS in insecticide treated plots whereas, in biopesticides sprayed plots the population decline continued till 14 DAS. At 14 DAS chlorantraniliprole 20SC @ 30 g a.i./ha recorded effective treatment with least number of larvae (0.07/plant) which was equally good with Belt Expert 480SC @ 120 g a.i./ha (0.13/plant), followed by flubendiamide 480SC @ 60 g a.i./ha (0.20/plant). Next in order of effectiveness were chlorpyrifos (0.50/plant), *M. anisopliae* (0.67/plant), *B. bassiana* (0.73/plant) and *V. lecanii* (0.80/plant), respectively.

The mean population data and reduction over control (%) after two sprays indicated that, chlorantraniliprole 20SC (0.28/ plant with 84.56% reduction) and Belt Expert 480SC (0.36/ plant with 80.41% reduction) found superior over other treatments with least population. It was followed by flubendiamide 480SC (0.42/ plant with 76.72% reduction). Among biopesticides, *M. anisopliae* (1.11/ plant with 38.95% reduction) found effective as compared to *B. bassiana* (1.18/ plant with 35.03% reduction) and *V. lecanii* (1.25/ plant with 31.66% reduction).

b. Effect on *Spodoptera* spp.

The results revealed that, one day before spray (DBS) there was no significant difference among the treatments and the population of *Spodoptera* spp. ranged from 2.67 to 3.33 larvae per metre row length (Table 2). At three days after the first spray, there was reduction in the number of larvae per plant which ranged from 0.33 to 2.67 per mrl and all the treatments were significantly lower than that in untreated control. The plots treated with chlorantraniliprole 20SC @ 30 g a.i./ha recorded least number of larvae (0.33/mrl) which was equally good with Belt Expert 480SC @ 120 g a.i./ha (0.67/ mrl), followed by flubendiamide 480SC @ 60 g a.i./ha (1.00 / mrl). Almost a similar trend of effectiveness of chemicals was observed at 7 DAS. Whereas, at 10 DAS, the plots treated with Belt Expert 480SC @ 120 g a.i./ha recorded least number of larvae (0.33/ mrl) which was equally good with chlorantraniliprole 20SC @ 30 g a.i./ha (0.67/ mrl), followed by flubendiamide 480SC @ 60 g a.i./ha (1.00 / mrl). Next in order of effectiveness were chlorpyrifos (1.67/ mrl), *M. anisopliae* (1.33/ mrl), *B. bassiana* (2.00/ mrl) and *V. lecanii* (2.33/ mrl), respectively.

The data presented in Table 2 also indicated that the population of *Spodoptera* after second spray gradually declined from 3 to 14 DAS. At 3 DAS, Belt Expert 480SC @ 120 g a.i./ha recorded least number of larvae (1.00/ mrl) which was equally good with chlorantraniliprole 20SC @ 30 g a.i./ha (2.00/ mrl), followed by flubendiamide 480SC @ 60 g a.i./ha (2.33/ mrl). Similar trend of effectiveness was observed at 7 and 10 DAS, respectively. At 14 DAS, Belt Expert 480SC @ 120 g a.i./ha was the most effective treatment with least number of larvae (0.33/ mrl) which was equally good with chlorantraniliprole 20SC @ 30 g a.i./ha (0.67/ mrl), followed by flubendiamide 480SC @ 60 g a.i./ha (1.00/ mrl). Next in order of effectiveness were *M. anisopliae* (1.33/ mrl), chlorpyrifos (1.67/ mrl), *B. bassiana* (2.00/ mrl) and *V. lecanii* (2.33/ mrl), respectively.

The mean population data and reduction over control (%) after two sprays indicated that, Belt Expert 480SC (0.52/mrl with 88.44% reduction) found superior over other treatments with least population and higher reduction. It was followed by chlorantraniliprole 20SC (1.00/mrl with 77.90% reduction) and flubendiamide 480SC (1.38/mrl with 69.50% reduction). Among biopesticides, *M. anisopliae* (1.76/mrl with 61.07% reduction) found effective as compared to *B. bassiana* (2.43/mrl with 46.32% reduction) and *V. lecanii* (2.86/mrl with 36.85% reduction).

c. Effect on fruit damage, yield and cost economics

Statistically significant variation was observed for fruit infestation in percentage (number basis) after first spray. The fruit damage was recorded in the range of 11.03 to 12.83 percent on the day before spray. After first spray, the data on mean fruit damage indicated that the plots treated with Belt Expert 480SC recorded least fruit damage (8.21%) and was found at par with chlorantraniliprole 20SC (8.65%), which was followed by flubendiamide 480SC (8.87%). Next in order of effectiveness were chlorpyrifos (10.40%), *M. anisopliae* (10.62%), *B. bassiana* (10.90%) and *V. lecanii* (12.40%), respectively. However, highest damage was observed in untreated control (13.14%). Similar trend of effectiveness was observed after second spray also (Table 3).

The results pertaining to the green chilli yield after harvest (multiple pickings) are presented in Table 3. The data revealed that the green chilli yield in all the treatments were significantly higher than untreated control. The plots treated with Belt Expert 480SC recorded highest yield of 229.40 q/ha with maximum percent increase over control (33.13%). This was followed by chlorantraniliprole 20SC (222.53 q/ha with 31.07% increase) and flubendiamide 480SC (216.67 q/ha with 29.20% yield increase over control). Next best treatments were, chlorpyrifos (199 q/ha), *M. anisopliae* (173.40 q/ha), *B. bassiana* (168.13 q/ha) and *V. lecanii* (163.47 q/ha), respectively.

Cost effectiveness of each treatment could be analysed based on net returns. The highest gross and net returns of Rs. 4,58,800 and Rs. 3,97,968 was recorded in the treatment of Belt Expert 480SC, which was at par with chlorantraniliprole 20SC (gross returns of Rs. 4,45,067 and net returns of Rs. 3,83,732, respectively). The highest B:C ratio of 7.54 was recorded in the treatment of T_1 - Belt Expert 480SC. It was however, at par with T_6 - chlorantraniliprole 20SC (7.26) followed by T_2 - flubendiamide 480SC @ 60 g a.i./ha (7.13).

The highest ICBR of 1:38.64 was recorded in chlorpyrifos, which showed that for every 1 rupee spent Rs. 38.64 of return was gained. However, the tested chemical Belt Expert 480SC recorded the ICBR of 1: 33.83.

The efficacy of flubendiamide was studied by several workers in chilli, but the combination of flubendiamide + thiacloprid was not studied. The thiacloprid effectiveness studies were lacking against fruit borers, because the insecticide was effective against sucking pests, however the similar works conducted to study the efficacy of flubendiamide was discussed to support the present study. The present study was in corroboration with investigations of Tatagar *et al.* [15] reported that flubendiamide 20 WG @ 60 g a.i. /ha recorded highest chilli yield of 7.48 q/ha with lowest fruit damage of 3.45 percent followed by flubendiamide 20 WG @ 40 g a.i./ ha (6.72 q/ha), emamectin benzoate 5 SG @ 11 g a.i./ha (7.22 q/ha) and spinosad 45 SC @ 75 g a.i./ha (7.32q/ha). Sreenivas *et al*. [14] reported that flubendiamide 480SC @ 48 g ai ha-1 was the most effective treatment in reducing the larval population of *Spodoptera litura* to 0.47 larvae per row and *Helicoverpa armigera* to 0.40 larvae per plant at 10 days after spray and recorded highest fruit yield of 25.12 q ha^{-1}. Ameta and Ajaykumar [1] who reported that, flubendiamide @ 60 g ai ha-l caused significantly higher reduction in the population of both the species of insect pests and also recorded the highest marketable fruit yield of chilli.

Kambrekar et al. [8] reported that emamectin benzoate 5% SG (Volax) @ 12 g a.i /ha has recorded lowest larval population of *H. armigera* in chilli after both the sprays with 0.16 and 0.07 larvae per plant, respectively. Mallikarjunappa *et al.* [11] who reported that flubendiamide 20 WG @ 35 g a.i./ha was the most effective in reducing the incidence of rice stem borer, *Scirphophaga incertulas* (Walker) and leaf folder *Cnaphalocrosis medinalis* (Guen.) and recorded higher yield. Similar results were also obtained by Lakshminarayana and Rajashri [10] who reported that flubendiamide 20 WG was highly effective against, *H. armigera* on cotton. Javaregowda and Nalk [7] reported that flubendiamide 20 WDG was very effective against paddy pests. Masanori *et al.* [12] reported that flubendiamide is highly effective against lepidopteran insects.

Table 1: Evaluation of Belt Expert 480SC on chilli fruit borer, *Helicoverpa armigera* (*rabi* - 2017)

Treatment details		Larvae per plant									ROC (%)
		First spray				Second spray				Mean after two sprays	
		DBS	3 DAS	7 DAS	10 DAS	3 DAS	7 DAS	10 DAS	14 DAS		
T_1	Belt Expert 480 SC	1.73	0.60	0.27	0.20	0.60	0.43	0.27	0.13	0.36*	80.41
		(1.49)	(1.05)	(0.88)	(0.84)	(1.05)	(0.97)	(0.88)	(0.80)	(0.93)	
T_2	Fame 480 SC	1.67	0.67	0.33	0.27	0.67	0.50	0.33	0.20	0.42	76.72
		(1.47)	(1.08)	(0.91)	(0.88)	(1.08)	(1.00)	(0.91)	(0.84)	(0.96)	
T_3	Bio-Magic	1.73	1.63	1.47	1.23	1.03	0.93	0.83	0.67	1.11	38.95
		(1.49)	(1.46)	(1.40)	(1.32)	(1.24)	(1.20)	(1.15)	(1.08)	(1.27)	
T_4	Bio-Power	1.80	1.67	1.53	1.30	1.13	1.03	0.90	0.73	1.18	35.03
		(1.52)	(1.47)	(1.43)	(1.34)	(1.28)	(1.24)	(1.18)	(1.11)	(1.30)	
T_5	Bio-Catch	1.87	1.71	1.57	1.37	1.20	1.10	0.97	0.80	1.25	31.66
		(1.54)	(1.49)	(1.44)	(1.37)	(1.30)	(1.25)	(1.21)	(1.14)	(1.32)	
T_6	Coragen 20 SC	1.73	0.53	0.20	0.13	0.47	0.37	0.20	0.07	0.28	84.56
		(1.49)	(1.02)	(0.84)	(0.80)	(0.98)	(0.93)	(0.84)	(0.75)	(0.88)	
T_7	Dursban 20EC	1.87	1.23	1.03	0.87	0.77	0.67	0.43	0.50	0.79	56.90
		(1.54)	(1.32)	(1.24)	(1.17)	(1.13)	(1.08)	(0.97)	(1.00)	(1.13)	

T_8	Control	1.93	1.73	2.03	1.87	1.73	1.77	1.83	1.80	1.82	--
		(1.56)	(1.49)	(1.59)	(1.54)	(1.49)	(1.51)	(1.53)	(1.52)	(1.52)	
	S.Em ±	NS	0.14	0.53	0.35	0.41	0.11	0.28	0.14	0.53	0.35
	CD @ 5%	NS	0.43	1.67	1.07	1.25	0.31	0.69	0.42	1.67	1.07

Note: DBS – Day before spray, DAS – Day after spray, Figures in the parentheses are subjected to square root transformation, ROC – Reduction Over Control; *-mean of post treatment count after each spray.

Table 2: Evaluation of Belt Expert 480SC on chilli fruit borer, *Spodoptea* spp. (*rabi* - 2017)

Treatment details	Larvae per mrl									ROC (%)
	First spray				Second spray				Mean after two sprays	
	DBS	3 DAS	7 DAS	10 DAS	3 DAS	7 DAS	10 DAS	14 DAS		
T_1 Belt Expert 480 SC	2.67	0.67	0.33	0.33	1.00	0.67	0.33	0.33	0.52*	88.44
	(1.78)	(1.08)	(0.91)	(0.91)	(1.22)	(1.08)	(0.91)	(0.91)	(1.01)	
T_2 Fame 480 SC	3.00	1.00	1.33	1.00	2.33	1.67	1.33	1.00	1.38	69.50
	(1.87)	(1.22)	(1.35)	(1.22)	(1.68)	(1.47)	(1.35)	(1.22)	(1.37)	
T_3 Bio-Magic	3.33	1.33	1.67	1.33	2.67	2.33	1.67	1.33	1.76	61.07
	(1.96)	(1.35)	(1.47)	(1.35)	(1.78)	(1.68)	(1.47)	(1.35)	(1.50)	
T_4 Bio-Power	2.67	2.00	2.67	2.00	3.00	3.00	2.33	2.00	2.43	46.32
	(1.78)	(1.58)	(1.78)	(1.58)	(1.87)	(1.87)	(1.68)	(1.58)	(1.71)	
T_5 Bio-Catch	3.00	2.67	2.67	2.33	3.67	3.33	3.00	2.33	2.86	36.85
	(1.87)	(1.78)	(1.78)	(1.68)	(2.04)	(1.96)	(1.87)	(1.68)	(1.83)	
T_6 Coragen 20 SC	3.33	0.33	1.00	0.67	2.00	1.33	1.00	0.67	1.00	77.90
	(1.96)	(0.91)	(1.22)	(1.08)	(1.58)	(1.35)	(1.22)	(1.08)	(1.22)	
T_7 Dursban 20EC	3.00	1.67	2.00	1.67	3.00	2.67	2.00	1.67	2.10	53.65
	(1.87)	(1.47)	(1.58)	(1.47)	(1.87)	(1.78)	(1.58)	(1.47)	(1.61)	
T_8 Control	3.33	4.67	4.33	5.67	4.00	4.33	4.67	4.00	4.52	--
	(1.96)	(2.27)	(2.20)	(2.48)	(2.12)	(2.20)	(2.27)	(2.12)	(2.24)	
S.Em ±	NS	0.61	0.51	0.39	0.48	0.66	0.37	0.44	0.49	
CD @ 5%	NS	1.89	1.55	1.17	1.46	1.99	1.12	1.34	1.50	

Note: DBS – Day before spray, DAS – Day after spray, Figures in the parentheses are subjected to square root transformation. mrl – metre row length, ROC – Reduction Over Control; *-mean of post treatment count after each spray.

Table 3: Effect of Belt Expert 480SC on chilli fruit borer damage, yield and its cost economics (*rabi* - 2017)

Treatment details	Fruit damage (%)			Yield (qts/ha)	Increase in yield over control (%)	Cost economics			
	DBS	First spray	Second spray			Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio	ICBR
T_1 Belt Expert 480 SC	12.83	8.21	1.73	229.40	33.13	458800	397968	7.54	33.83
	(20.99)	(16.65)	(7.56)						
T_2 Fame 480 SC	12.40	8.87	3.14	216.67	29.20	433333	372588	7.13	28.72
	(20.62)	(17.33)	(10.21)						
T_3 Bio-Magic	11.88	10.62	3.67	173.40	11.53	346800	287242	5.82	12.43
	(20.16)	(19.02)	(11.04)						
T_4 Bio-Power	11.98	10.90	5.91	168.13	8.76	336267	276709	5.65	9.16
	(20.25)	(19.28)	(14.07)						
T_5 Bio-Catch	11.03	12.40	6.66	163.47	6.16	326933	267375	5.49	6.26
	(19.39)	(20.62)	(14.96)						
T_6 Coragen 20 SC	12.13	8.65	2.38	222.53	31.07	445067	383732	7.26	27.68
	(20.38)	(17.10)	(8.88)						
T_7 Dursban 20EC	12.78	10.40	5.04	199.00	22.91	398000	339300	6.78	38.64
	(20.95)	(18.81)	(12.97)						
T_8 Control	12.01	13.14	9.90	153.40	-	-	-	-	-
	(20.27)	(21.26)	(18.34)						
S.Em ±	0.78	0.89	0.51	0.77	-	-	-	-	-
CD @ 5%	2.37	2.71	1.55	2.34	-	-	-	-	-

Note: DBS – Day before spray; Figures in the parentheses are subjected to arcsine transformation.

Belt Expert 480 SC – Rs. 599 per 50ml	Fame 480 SC – Rs. 962 per 50ml
Bio-Magic – Rs.406 per 1 L	Bio-Power – Rs.406 per 1 lit.
Bio-Catch – Rs.406 per 1 L	Coragen 20 SC – Rs. 997 per 60ml
Dursban 20EC – Rs. 180 per 500ml	Labour cost – Rs. 1800 per ha
Cost of cultivation – Rs. 56,340 per ha	Cost of green chilli fruits – Rs. 20 per kg
Cost of spray equipment – Rs. 200	

4. Conclusion

The present study concluded that the tested insecticide combiproduct, flubendiamide 240+ thiacloprid 240 (Belt Expert 480SC) was effective in reducing chilli fruit borer population and fruit damage, which was at par with Coragen 20 SC. Interestingly, Belt Expert 480SC was also found reducing the thrips damage, which was an additional observation. The green chilli yield and cost economics showed that the plots treated with Belt Expert 480SC recorded higher yield, net returns and B:C ratio. Overall, the Belt Expert 480SC was the most promising and cost effective treatment, which may be recommended against fruit borers in chilli.

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6. References

1. Ameta OP, Bunker GK. Efficacy of NNI 0001 (Flubendiamide) 480 SC against diamond back moth, *Plutella xylostella* in cabbage and its effects on natural enemies under field conditions. Pestology. 2007; 31(6):21-24.
2. Anonymous, Asian Vegetable Research and Development C0entre. Progress Report, 1987, 77-79.
3. Anonymous, Department of Agriculture and Cooperation Agricultural Statistics at a glance (Horticulture Division), 2015.
4. Anonymous, Department of Agriculture and Cooperation Agricultural Statistics at a glance (Horticulture Division), 2016.
5. Anonymous, Improved cultivation practices for field crops, University of Agricultural Sciences, Dharwad, 2004, 227-234.
6. Gomez KA, Gomez AA. Statistical procedures for Agricultural Research, Second edition, John wiley and sons. New York, 1984, 582.
7. Javaregowd, Nalk LK. Bio-efficacy of flubendiamide 20 WDG (RIL-038) aganist paddy pests and their natural enemies. Pestology. 2005; 29:58-60.
8. Kambrekar DN, Halagalimath SP, Somanagouda G. Management of chilli fruit borer, *Helicoverpa armigera* with emamectin benzoate 5% SG (Volax). 3rd International Conference on Agriculture and Horticulture, 2014, http://dx.doi.org/10.4172/2168-9881.S1.011
9. Katagihallimath SS, Chilli *(Capsicum annuum* L.) a new host plant of *Heliothis armigera* Hubner. Current Science. 1963, 32:464-465.
10. Lakshminarayana S, Rajashri M. Flubendiamide 20% WG a new molecule for the management of American bollworm, *Helicoverpa armigera* on cotton. Pestology. 2006; 30:16-18.
11. Mallikarjunappa S, Kendappa GN, Ganesh Bhat U. Flubendiamide 20% WG-a novel insecticide for the control of rice stemborer, *Scirphophaga incertulas* and leaf folder *Cnaphalocrosis medinalis.* In Coleman memorial National Symp. On Plant prot., Univ. Agric. Sci., GKVK, Bangalore, 2008, 4-6.
12. Masanori T, Hayami N, Fujioka S. Flubendiamide, a novel insecticide highly effective against lepidopteran insect pests. Journal of Pesticide Sciences, 2005, 30:354-360.
13. Reddy MRS, Reddy GS. An eco friendly method to combat *Helicoverpa armigera* (Hub.). Insect Environment, 1999, 4:143-144.
14. Sreenivas AG, Sharanabasappa, Hosamani AC, Bheemanna M, Suresh BK, Shivaleela *et al*., Efficacy of flubendiamide 480 SC against chilli fruit borers complex. Pesticide Research Journal, 2008; 20(2):243-246.
15. Tatagar MH, Mohankumar HD, Shivaprasad M, Mesta RK. Bio-efficacy of flubendiamide 20 WG against chilli fruit borers, *Helicoverpa armigera* (Hub.) and *Spodoptera litura* (Fb.). Karnataka Journal of Agricultural Sciences. 2009; 22(3):579-581.