

ASSESSMENT OF CHEMICAL INSECTICIDE AND PHEROMONE TRAP TECHNOLOGY FOR MANAGEMENT OF *Helicoverpa armigera* IN TOMATO

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ABSTRACT

An on farm trial was formulated during *rabi* 2021-2022, 2022-2023 and 2023-2024 to assess efficacy of Flubendiamide 20 SC and pheromone trap technology for management of fruit borer in tomato crop in Vyara block of Tapi district. The experiment was conducted by adopting different management practices i.e. T₁-One spray of Profenofos 50 EC@1.0 ml l⁻¹ of water usually after outbreak of pest (farmers practice), T₂-Spraying of Flubendiamide 20 WG @ 0.005% (2.5 g 10 litre⁻¹ of water). First spray was carried out at flowering stage and second spray 15 day after first spray. T₃-Installation of pheromone trap @ 40 trap ha⁻¹ and lure were change at an interval of 21 days and T₄- untreated control. The pooled results revealed that significantly the lowest number of fruits (37.0) damaged and larval population twenty plant⁻¹ (16.69) was found in treatment T₂ (Spraying of Flubendiamide 20 WG @ 0.005% (2.5 g 10 litre⁻¹ of water)) and significantly the highest number of fruit damaged (111.0) and larval population twenty⁻¹ plants (58.03) were found in treatment T₄ (Untreated control) as compared to T₂ and T₃ treatments. The mean data of per cent fruit infestation revealed that 16.3 and 19.3 per cent fruit infestation was observed in T₁ (farmers practice) and T₄ (Untreated control), respectively, whereas only 7.6 and 11.7 per cent fruit infestation was recorded in T₂ and T₃ treatments. The mean data of number adult moth trapped trap⁻¹ was 17.86 recorded in treatment T₃ (Installation of pheromone trap @ 40 trap ha⁻¹ and lure were changed at an interval of 21 days). The maximum mean fruit yield (240 q ha⁻¹) was recorded in assessed treatment T₂ followed by treatment T₃ (224 q ha⁻¹) and the minimum mean fruit yield (187 q ha⁻¹) was recorded in treatment T₄ (Untreated control). The maximum mean net return of ₹1,65,167 ha⁻¹ and B:C ratio of 3.47 was recorded by treatment T₂ followed by treatment T₃ (₹ 149973/3.27) and the minimum net return and B:C ratio was recorded in treatment T₄ i.e. Untreated control (₹ 80967/2.11).

(Key words: Tomato, *Helicoverpa armigera*, On farm trials, yield and B:C ratio)

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) is an integral part of Indian kitchen and consumed as raw and cooked vegetable due to its nutritional property. Tomato is rich source of lycopene and contains minerals, fibers, protein and essential amino acids (Ali *et al.*, 2021). In India, tomato is being cultivated in 8.45 lakh hectare area with 21.18 Mt production (Anonymous, 2021). Tomato is one of the important crops cultivated about 419 ha area with 9075 MT production and 21660 kg ha⁻¹ productivity in Tapi district and mainly cultivated in *kharif* and summer season. Fruit borer, *Helicoverpa armigera* Hübner is an important pest as biotic constraint of tomato cultivation. *H. armigera* is voracious feeder that feed on tomato fruit and make them unfit for human consumption. Infested fruit ultimately rooted by saprophytic action of microorganism. Yield losses due

to *H. armigera* ranging from 23-74% have been documented under Indian condition in tomato crop (Rai *et al.*, 2014). Most of time management of this pest solely depends on use of chemical insecticides. The use of insecticides for pest control has negative consequences, such as the development of insecticide resistance in the pests, resurgence of the pests, environmental contamination and health risks. Therefore, strategies that reduces heavy load of insecticide and comprises of environmental safer approaches are prerequisite toward sustainability. Hence, an on-farm trial was designed on assessment of chemical insecticide and pheromone trap technology for management of *Helicoverpa armigera* in tomato.

MATERIALS AND METHODS

An on farm trial was formulated to assess of chemical insecticide and pheromone trap technology for

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management of *Helicoverpa armigera* in tomato during *rabi* 2021-22, 2022-23 and 2023-24. Farmers were randomly selected from Fulvadi, Hanumantiya and Ramkua villages of Vyara block and area under each trial was 0.2 ha. The trials were carried out in Randomized Block Design (RBD) with 5 replications for each treatment. Tomato hybrid Vaishali was cultivated and all the agronomic practices recommended by Navsari agricultural university, Navsari were followed. Experiment was conducted by adopting different management practices i.e. T₁-One spray of Profenofos 50 EC @1.0 ml l⁻¹ of water usually after outbreak of pest (farmers practice), T₂-Spraying of Flubendiamide 20 WG @ 0.005% (2.5 g 10 litre⁻¹ of water) in which first spray was carried out at flowering stage and second spray 15 day after first spray, T₃-Installation of pheromone trap @ 40 trap ha⁻¹ and lure were change at an interval of 21 days and T₄- Untreated control. Pheromone trap was installed at 40 days of transplanting and made weekly observation for trapped adult. Data of pheromone trap was used for spray scheduling. In the field, twenty plants were selected randomly and take observations from randomly selected plants. During fruiting stage, number of healthy fruits and damaged fruits on 20 randomly selected plants were recorded. In order to determine the percentage of fruit infested with fruit borer, the number of fruits with borer holes and the total number of fruits inspected from each plot were recorded. Additionally, the yield of each harvest was recorded separately and the total yield was estimated in quintals ha⁻¹. Number of larvae plant⁻¹ was also recorded. The marketable yield was used to determine a B:C ratio for the economic feasibility of the most appropriate management strategy against fruit borer. Data were subjected to analysis of variance determined at 5 per cent probability. B:C ratio was calculated based on the market price of tomato fruits, the rate of pesticides and the cost of labour (Baral *et al.*, 2006).

RESULTS AND DISCUSSION

The number of fruit damaged, per cent fruit infestation, number of larvae twenty randomly selected plant⁻¹ and trapped adult trap⁻¹ were observed and data are presented in Table 1 and Table 1a. The pooled results revealed that significantly the lowest number of fruit (37.0) damaged was found in treatment T₂ (Spraying of Flubendiamide 20 WG @ 0.005% (2.5 g 10 litre⁻¹ of water)) and significantly the highest number of fruit (111.0) damaged was found in treatment T₄ (Untreated control). The mean data of per cent fruit infestation revealed that 16.3 and 19.3 per cent fruit infestation was recorded in treatment T₁ (farmer s practice) and T₄ (Untreated control), respectively, whereas only 7.6 and 11.7 per cent fruit infestation was recorded in T₂ and T₃ treatments. Significantly the lowest larval population twenty plant⁻¹ (16.69) was recorded in treatment T₂ (Spraying of Flubendiamide 20 WG @ 0.005% (2.5 g 10 litre⁻¹ of water)) and significantly the highest larval population twenty⁻¹ plants (58.03) was found in treatment

T₄ (Untreated control) as compared to T₂ and T₃ treatments in pooled results. The mean data of number adult moth trapped trap⁻¹ was 17.86 recorded in treatment T₃ (Installation of pheromone trap @ 40 trap ha⁻¹ and lure were changed at an interval of 21 days). Application of Flubendiamide 20 WG found best effective as compared to profenofos 50EC, where it was kept larval population plant⁻¹ below economic threshold level and low fruit infestation. Reddy *et al.* (2021) also found significant result of Flubendiamide 20 WG application and recorded only 56.74 per cent population reduction of *Helicoverpa armigera* (Hubner) on tomato. Regmi *et al.* (2018) reported Flubendiamide was the most effective treatment in controlling the fruit borer population in tomato. Ambule *et al.* (2015) reported that Flubendiamide 0.004% recorded minimum (10.09%) tomato fruit damage. Similarly Anil *et al.* (2010) clearly indicated that new generation insecticides like Flubendiamide was found effective against Lepidopteran pest. Kachave *et al.* (2020) indicated minimum mean larval population of *H. armigera* in Flubendiamide 20 WG @ 100 g ha⁻¹ (0.54 larva plant⁻¹) and significantly maximum per cent reduction of fruit damage by *H. armigera* was observed in Flubendiamide 20 WG @ 100 g ha⁻¹ (66.31%). Larval population was recorded under ETL in assessed treatment (T₂). Likewise, Ravi *et al.* (2008) in their experiment pointed that treatment comprised of application of three insecticides kept *H. armigera* larval count bellow 0.50 and 0.25 for first and second spray, respectively. Thilagam and Gopikrishnan (2020) reported 1.43 and 1.14 larvae plant⁻¹ during flowering and pod formation stage respectively. Reddy *et al.* (2021) observed trapped moth pheromone trap⁻¹ was 17.86, however average moth trapped trap⁻¹ varied from 4.50 to 20.50 during 33 to 49 standard meteorological weeks.

The data on economic performance (Table 3) indicated that the maximum mean fruit yield (240 q ha⁻¹) was recorded in assessed treatment-T₂ followed by treatment T₃ and the minimum mean fruit yield (187 q ha⁻¹) was recorded in treatment T₄ (Untreated control). Reddy *et al.* (2021) observed the highest fruit yield of tomato (172 q ha⁻¹) and lowest fruit infestation with the application of Flubendiamide 20% WG. Similar results were recorded by Kachave *et al.* (2020). They observed the highest marketable fruit yield of tomato by the application of Flubendiamide 20 WG @ 100 g ha⁻¹ (59.72 q ha⁻¹). The mean net return of ₹ 1,65,167 ha⁻¹ of assessed technology was recorded by treatment T₂ followed by treatment T₃. The minimum net return of ₹ 80,967 ha⁻¹ was recorded by treatment T₄ (Untreated control). The above findings are supported with the results reported by Ambule *et al.* (2015) that higher marketable tomato fruit yield was recorded from treatment of Flubendiamide. The maximum B:C ratio of 3.47 was recorded by treatment T₂ followed by treatment T₃ (3.27) and the minimum B:C ratio was recorded in treatment T₄ (2.11) (Untreated control).

Judicious pesticide application saved extra cost of cultivation and also maintains ecological equilibrium. Results of present study clearly inferred that foliar spray of

Table 1. Effect of treatments on fruit damaged and larva and adult population of fruit borer of tomato

Treatments	Numbers of fruit damaged plot ⁻¹				% damaged fruits			
	2022	2023	2024	Pooled	2022	2023	2024	Mean
T ₁ : Farmers practice as injudicious and indiscriminate use of chemical pesticide	84	98	72	84.6	14	16	19	16.3
T ₂ : Spraying of Flubendiamide 20 WG @ 0.005% (2.5 g 10 litre ⁻¹ of water) First spray was carried out at flowering stage and second spray 15 day after first spray	48	43	20	37.0	8	7	8	7.6
T ₃ : Installation of pheromone trap @ 40 trap ha ⁻¹ and lure were changed at interval of 21 days	66	62	35	54.3	11	10	14	11.7
T ₄ : Untreated control	102	141	90	111	16	19	23	19.3
SE(m)±	1.31	2.32	1.78	1.24	-	-	-	-
CD(5%)	3.93	6.96	5.34	3.72	-	-	-	-

Table 1a. Effect of treatments on fruit damaged and larva and adult population of fruit borer of tomato.

Treatments	Numbers of Larva 20 randomly selected plants ⁻¹				Trapped adult trap ⁻¹			
	2022	2023	2024	Pooled	2022	2023	2024	Mean
T ₁ : Farmers practice as injudicious and indiscriminate use of chemical pesticide	41.56	40.2	39.7	40.48	-	-	-	-
T ₂ : Spraying of Flubendiamide 20 WG @ 0.005% (2.5 gm 10 litre ⁻¹ of water). First spray was carried out at flowering stage and second spray 15 day after first spray	16.09	17.9	16.1	16.69	-	-	-	-
T ₃ : Installation of pheromone trap @ 40 trap ha ⁻¹ and lure were changed at an interval of 21 days	23.98	28.3	29.0	27.09	11.4	18.2	24.0	17.86
T ₄ : Untreated control	58.10	54.7	62.1	58.03	-	-	-	-
SE(m)±	1.05	1.22	1.28	0.29	-	-	-	-
CD(5%)	3.15	3.66	3.84	0.87	-	-	-	-

Table 2. Economic performance of different treatments

Treatments	Parameters of assessment	Data on the parameter year wise				
		2021-22	2022-23	2023-24	Mean	
T ₁ - Farmers practice as injudicious and indiscriminate use of chemical pesticide	Production (q ha ⁻¹)	198	197	203	199	
	Cost of Cultivation (₹ ha ⁻¹)	68000	68100	68340	68147	
	Gross return (₹ ha ⁻¹)	198000	187150	192850	192667	
	Net Return (Profit) ₹ unit ⁻¹	130000	119050	124510	124520	
T ₂ - Spraying of Flubendiamide 20 WG @ 0.005% (2.5g 10 litre ⁻¹ of water). First spray was carried out at flowering stage and second spray 15 day after first spray	B:C Ratio	2.91	2.75	2.82	2.83	
	Production (q ha ⁻¹)	236	239	245	240	
	Cost of Cultivation (₹ ha ⁻¹)	66500	66600	67200	66767	
	Gross return (₹ ha ⁻¹)	236000	227050	232750	231933	
T ₃ - Installation of pheromone trap @ 40 trap ha ⁻¹ and lure were changed at an interval of 21 days	Net Return (Profit) ₹ unit ⁻¹	169500	160450	165550	165167	
	B:C Ratio	3.55	3.41	3.46	3.47	
	Production (q ha ⁻¹)	218	221	232	224	
	Cost of Cultivation (₹ ha ⁻¹)	65000	66540	66890	66143	
T ₄ - Untreated control	Gross return (₹ ha ⁻¹)	218000	209950	220400	216117	
	Net Return (Profit) ₹ unit ⁻¹	153000	143410	153510	149973	
	B:C Ratio	3.35	3.16	3.29	3.27	
	Production (q ha ⁻¹)	183	186	191	187	
	Cost of Cultivation (₹ ha ⁻¹)	70000	79100	70340	73147	
	Gross return (₹ ha ⁻¹)	142740	158100	161500	154113	
	Net Return (Profit) ₹ unit ⁻¹	72740	79000	91160	80967	
	B:C Ratio	2.04	2.00	2.30	2.11	

Flubendiamide 20 WG, based on trapped adult moth, significantly lower down larval population of *H. armigera*, lowest fruit infestation, highest yield and higher B:C ratio as compared to blanket application of profenofos 50EC.

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