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Efficacy of Different Insecticide Modules on Tomato Pin Worm, *Phthorimaea absoluta*

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Abstract: Tomato pin worm, *Phthorimaea absoluta* (Meyrick) (Lepidoptera: Gelechiidae) is an invasive pest on tomato and was first reported in India during 2014 and has spread to several tomato growing states. An experiment was conducted to know the efficacy of different modules. The three modules include Integrated module: Installation of pheromone traps (25/ha), collection and destruction of infested parts, spraying of Azadirachtin @3-5ml/L after 30 Days after transplanting, spraying of emamectin benzoate @0.4g/L 10 days after first spray, spraying of chlorantraniliprole @0.3ml/L 10 days after second spray; Bio intensive model: installation of pheromone traps (25/ha), spraying of NSKE5% after appearance of pest, spraying of Pongamia soap @10g/L 10 Days after first spray, spraying of Neem soap @10g/L 10 days after second spray, Spinosad 45 SC @0.3ml/L 10days after third spray, Chemical Module: Spraying of Lamdacyhalothrin @2.5ml/L at 3days after transplanting, followed by spraying of indoxacarb 14.5 SC @ 1ml/L at 10 days after first spray followed by Chlorantraniliprole @ 0.3 ml/L 10 days after second spray and Novaluron 10EC @ 1.5 ml/L at 10 days after third spray and Untreated control. All the modules were significantly superior over control. Among the modules tested chemical module and integrated modules were superior in the management of *P.absoluta* followed by biointensive module. Live mines in integrated module reduced from 5.08 to1.97 per plant as against increase in live mines from 3.25 to 8.06 per plant in untreated control.

keywords: Tomato, Pinworm, *P. absoluta*, Insecticide, IPM Module

The South American tomato pinworm, *Phthorimaea absoluta* (Meyrick) (Lepidoptera: Gelechiidae), is an exterminatory pest presently undermining the worldwide tomato industry. Over the recent 10 years, it has spread and extended to a large portion of Europe, Africa and Asia, making broad harm the actual harvest and to the global tomato market (Campos et al 2017). *Phthorimaea absoluta* is an oligophagous pest related with solanaceous harvests, *viz*. tomato, brinjal, pepper, potato, tobacco and hardly any weeds (Ferracini et al 2012). It causes 50-100% decreases in yield and affects product quality in nurseries and fields (EPPO 2005). This pest was first detected infesting tomato fields in some districts of Maharashtra, India in 2014 (Shashank et al 2015). Subsequently was reported from Karnataka (Sridhar et al 2014, Kalleshwaraswamy et al 2015), Andhra Pradesh, Telangana (Kumari et al 2015), Tamil Nadu (Shanmugam et al 2016) and Gujarat (Ballal et al 2016). It has a huge biotic potential, as multivoltine nature, short generation period and expanded protection from chemical insecticides, and it achieved key pest status even in new environments (Biondi et al 2018). In general, around 12 classes of insecticides are used to control tomato pests (IRAC2009). Organophosphates and pyrethroids have been used since 1970 while during 1990s, abamectin, spinosad, tebufonzide and chlorfenpyr have been attempted (Lietti et al 2005). In any case, continuous failure to control the insect with organophosphates and pyrethroids in South America (Lietti et al 2005), has led to the appraisal of new more secure chemical insecticides for successful insect control (IRAC 2009). Indoxacarb, spinosad, imidacloprid, deltamethrin and *Bacillus thuringiensis* var. *kurstaki* have effectively been utilized against *P. absoluta* hatchlings in Spain (Russell 2009). Chlorpyrifos and pyrethrins are often utilized in Italy (Garzia et al 2009). The main control technique against *P. absoluta* is the utilization of synthetic insecticides which can give up to 95% control in the Mediterranean basin (Urbaneja et al 2012, Derbalah et al 2012). Hanafy and El-Sayed (2013) observed spinetoram displayed better impact in decreasing population of *P. absoluta* followed by spinosad. Other workers reported that various pesticides were successful against *P. absoluta* like spinosad (Bratu et al 2015, Abdelgaleil et al 2015), azadirachtin, emamectin benzoate, spinosad, chlorantraniliprole (Eleonora and Vili 2014) chlorantraniliprole + abamectin (Ali et al 2014), cyantraniliprole (Patricia et al 2014), indoxacarb and chlorantraniliprole (Roditakis et al 2013).

Sridhar et al (2019) considered entomopathogens (*Bacillus thuringiensis, Metarhizium anisopliae, Beauveria bassiana* and *M. rileyi*), egg parasitoids (*Trichogramma chilonis, T. pretiosum* and *Trichogrammatoidea bactrae*), light snares, pheromone traps, pesticides for their efficacy. Among the egg parasitoids *T. pretiosum* and among chemical insecticides spinetoram were observed to be exceptionally useful. Yellow light traps, Azadirachtin 5% EC showed good efficacy along with *M. anisopliae* demonstrating their combined use can be adequately used in the eco-accommodating management of *T. absoluta*. Consequently, utilization of synthetic compounds has debilitated the stability of crop ecosystems. Under such circumstances, the colonization and spread of this destroying pest might be the main challenge for conventional and organic farming. So, there is a pressing need to embrace information on its degree of harm, conservation of natural enemies and host plant resistance for shaping Integrated Pest Management (IPM) module for containment of this pest. It is necessary to create awareness among farmers about its *T. absoluta* and continuous monitoring to prevent its spread.

MATERIAL AND METHODS

The experiment was conducted in Telangana (17° 7' 23.4624'' N and 79° 12' 31.7664'' E) between 2017-2020. The experiment was laid out in 3 module T_1-Integrated module, T_2-Bio intensive module, T_3-Chemical Module and untreated control. Three replications were laid out for each module and untreated control. Observations on live mines of *P. absoluta* (hatchlings) were recorded on selected plants, representatively leaves each from top, center and lower part of the plant per replication. Fruits damaged by *P.absoluta* were recorded from each replication along with healthy fruits.

The components of T_1-Integrated module were : Installation of pheromone traps (10/acre), collection and destruction of infested parts, spraying of Azadirachtin @ 3-5ml/L at 30 Days after transplanting, spraying of Emamectin Benzoate @0.4g/L 10 days after first spray, spraying of chlorantraniliprole @ 0.3ml/L 10 days after second spray. Components of T_2-Bio intensive model were : Installation of pheromone traps (10/acre), spraying of NSKE5% after appearance of pest, spraying of Pongamia soap @10g/L 10 Days after first spray, spraying of Neem soap @10g/L 10 days after second spray, spraying of Spinosad 45 SC @0.3ml/L 10days after third spray. T_3-Chemical Module consisted of spraying of Lamdacyhalothrin @2.5ml/L at 3days after transplanting, Spraying of indoxacarb 14.5 SC @ 1ml/L at 10 days after first spray, spraying of chlorantraniliprole @ 0.3 ml/L 10 days after second spray, spraying of Novaluron 10EC @ 1.5 ml/L at 10 days after third spray and T_4 was Untreated control.

RESULTS AND DISCUSSION

All the three modules recorded higher damage control compared to the untreated control in all the three years of study (Table 1). In the first year in the vegetative stage, chemical module recorded highest control of larvae (77.24%) followed by integrated module and biointensive module. In the second year also, the same trend followed where all the modules performed better than the untreated control. Chemical module recorded highest damage control

Table 1. Evaluation of IPM modules for tomato pin worm (*Tuta absoluta*) (2017-18 to 2019-20)

Treatment	Vegetative precount (Number of larvae per plant)				Damage control (%)				Reproductive precount (Number of larvae per plant)				Damage control (%)			
	2017-18	2018-19	2019-20	Pooled	2017-18	2018-19	2019-20	Pooled	2017-18	2018-19	2019-20	Pooled	2017-18	2018-19	2019-20	Pooled
T_1	6.70	8.20	9.28	8.06	74.20	72.54	71.34	72.69	8.56	10.88	13.18	10.87	82.26	79.20	76.74	79.40
	(2.77)	(3.02)	(3.20)	(3.00)	(59.57)	(58.43)	(57.68)	(58.56)	(3.09)	(3.44)	(3.75)	(3.43)	(65.25)	(62.98)	(61.17)	(63.13)
T_2	7.97	9.12	10.54	9.21	62.76	60.64	51.56	58.32	7.83	9.36	11.52	9.57	67.93	63.14	61.48	64.18
	(2.99)	(3.18)	(3.39)	(3.19)	(52.44)	(51.16)	(45.88)	(49.83)	(2.96)	(3.21)	(3.52)	(3.23)	(55.57)	(52.62)	(51.64)	(53.28)
T_3	8.23	10.08	11.10	9.80	77.24	74.32	74.56	75.37	9.57	11.00	14.96	11.84	79.16	75.88	72.74	75.93
	(3.03)	(3.33)	(3.47)	(3.28)	(61.55)	(59.57)	(59.76)	(60.29)	(3.25)	(3.45)	(3.98)	(3.56)	(62.95)	(60.59)	(58.54)	(60.69)
T_4	8.11	9.60	12.12	9.94	15.50	17.56	18.36	17.14	10.32	12.15	16.26	12.91	16.76	16.82	18.96	17.51
	(3.01)	(3.25)	(3.62)	(3.29)	(23.10)	(24.75)	(25.35)	(24.40)	(3.36)	(3.62)	(4.15)	(3.71)	(24.09)	(24.16)	(25.80)	(24.68)
CD (5%)	NS	NS	0.98	0.85	7.32	5.55	6.09	6.42	1.81	NS	NS	1.24	6.62	6.14	3.57	4.34
CV	13.83	10.91	6.51	4.48	9.15	7.08	8.10	5.64	14.34	13.73	17.77	5.37	7.19	7.49	4.45	3.60
SeM±	0.48	0.45	0.31	0.24	2.35	1.78	1.96	1.82	0.58	0.67	1.11	0.35	2.12	1.97	1.15	1.23

(74.32%) followed by integrated module ,biointensive module. Untreated module recorded least damage control (17.56 %). In the third year the chemical module fared best again (74.56%) followed by integrated module and biointensive module (Table 1). Pooled data also confirmed the same findings. Chemical module recorded maximum damage control (75.37%) followed by integrated module and biointensive module. Untreated control recorded least damage control (17.14%) proving the efficacy of the chemical module over the integrated module and biointensive modules.

In the first year in the reproductive stage integrated module recorded highest damage control of larvae (82.26%) followed by chemical module and Bio intensive model. Untreated module recorded least damage control (16.76%). In the second year of reproductive stage Integrated module recorded highest damage control of larvae followed by chemical module and Bio intensive module Untreated module recorded least damage control in 2018. In the second year also, the same trend followed where all the modules performed better than the untreated control. In the third year of reproductive stage integrated module recorded highest damage control of larvae followed by chemical module and Bio intensive module. Untreated module recorded least damage control (18.96%) in 2019. In the third year again, the same trend followed where all the modules performed better than the untreated control. Pooled data also confirmed the same findings reproductive stage Integrated module recorded highest damage control of larvae (79.40%) followed by chemical module (and Bio intensive module. Untreated control recorded least damage control (17.51%) proving the efficacy of the treated module over the untreated module. Lamdacyhalothrin, indoxacarb, chlorantraniliprole in T_3-Chemical Module and biopesticides (T_1-Integrated module and T_2-Bio intensive module) were found effective in reducing the infestation of *P. absoluta*.

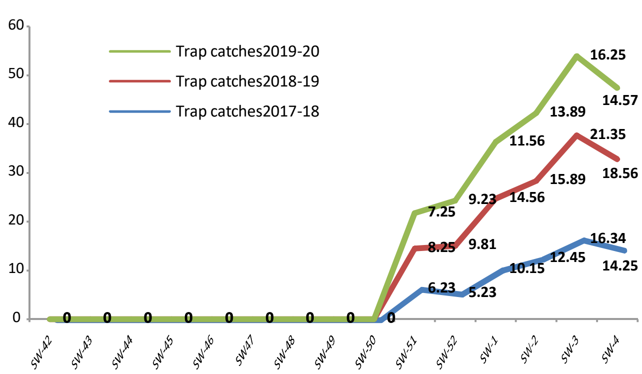

Fig. 1. Pheromone trap catch during the study period (2017-18 to 2019-20)

Pheromone trap catches during the study period indicated that *P. absoluta* catches started to rise from the 50th Standard week (6.23 to 8.25/trap/week) in all the years of study and increased at an increasing rate with a peak between the 3rd and 4th Standard meteorological week (14.25-21.35/trap/week). Trap catch came down after that as the crop sown in November was harvested by January second fortnight (5th standard week) (Fig. 1). Sridhar et al (2016) o reported that Spinetoram 12 SC @ 1.25ml/L, cyantraniliprole 10 OD @1. 8 ml/L, flubendiamide 480 SC@ 0.3ml/L and spinosad 45 SC@0.3ml/L were found more effective against *P.absoluta.* Halder et al (2019) reported that among the biopesticides, *Bacillus thuringiensis* var *kurstaki* gave encouraging results causing 66.7 and 73.37% mortality at 48 and 72 h after the treatment followed by *B. subtilis*-2

CONCLUSION

The integrated module along with the chemical module recorded lesser pest damage in both vegetative and reproductive stages of crop growth, but since keeping in view the importance of ecofriendly management techniques, the integrated module would help the farmer and ecosystem in the long run.

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