Indian Journal of Entomology 85(1): 249-252 (2023) DoI. No.: 10.55446/IJE.2022.446

EFFICACY OF SOME INSECTICIDES AGANIST INVASIVE PIN WORM *TUTA ABSOLUTA* (MEYRICK) AND RED SPIDER MITE *TETRANYCHUS URTICAE* (KOCH) ON TOMATO

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ABSTRACT

The pin worm *Tuta absoluta* (Meyrick) and red spider mite *Tetranychus urticae* (Koch) are major pests of tomato. A field experiment was carried out to evaluate the effectiveness of some insecticides against these at the College of Agriculture, Vijayapura, UAS, Dharwad. The results revealed that chlorantraniliprole 18.5%SC led to least number of larvae (1.60/ plant), live mines (1.26 live mines/ plant) and less fruit damage (2.06%) at fifth day of spray. Spiromesifen 22.9%SC led to significantly less number of mites (1.01/ square inch of leaf area) at third day of spray. The combination treatment of chlorantraniliprole 18.5%SC @ 0.15 ml/ l followed by spiromesifen 22.9%SC @ 0.5 ml/ l was found to be the best to manage both the pests.

Key words: Tomato, *Tuta absoluta, Tetranychus urticae,* chlorantraniliprole, spiromesifen, insecticides, live mines, fruit damage, combination

Tomato (*Lycopersicon esculentum*. L.) is an important vegetable crop mainly grown in tropics and subtropics, and falls under Solanaceae (Vavilov, 1951). Tomato pin worm *Tuta abosoluta* is an invasive alien pest species from South America which is spreading rapidly and causing considerable damage to tomato crop in recent years (Shashank et al., 2015). It is an oligophagous pest feeding on many related species of the family Solanaceae including tomato (*Solanum lycopersicum* L.), potato (*Solanum tuberosum* L.), eggplant (*Solanum melongena* L.), pepper (*Capsicum annuum* L.), sweet pepino (*Solanum muricatum* L.), tobacco (*Nicotiana tabacum* L.), the jimson weed (*Datura stramonium* L.), the African eggplant (*Solanum aethiopicum* L.), and the European black nightshade (*Solanum nigrum* L.) (Desneux et al., 2018). Pin worm attacks the apical buds, flowers, and new fruits of tomato. Larvae make conspicuous mines and galleries on leaves and stems. Damage can occur at any stage of tomato growth from seedlings to mature plant. The larvae feed on the mesophyll tissue, leaving the epidermis intact, thus creating irregular mines and galleries on the leaves. The mines and galleries may become necrotic with time. These mining activities lead to reduction of the photosynthetic potential in the infested leaves (Biondi et al., 2018).

Mites of the family Tetranychidae are among the destructive pests of agricultural and horticultural crops. *Tetranychus urticae* Koch, the two-spotted mite is a polyphagous one and probably the most important agricultural mite pest (Khalighi et al*.,* 2016). It has reported on many plants like tomato, okra, brinjal, cotton, french bean, cucurbits, alfalfa, flowers, etc. (Manjulata et al., 2002). Under optimal conditions of high temperatures and low humidity, *T. urticae* can build to high densities and cause serious damage, especially in greenhouses. The mite generally feeds underneath the leaves and causes greying of the leaves due to mesophyll collapse followed by yellowing. It is estimated that 18-22 cells are destroyed per minute by a single mite. Continued feeding causes a stippled–bleached effect and later, the leaves turn yellow, grey or bronze. Complete defoliation may occur, if the mites are not controlled (Park and Lee, 2002). The present study evaluates combination spray of insecticides and acaricides at different intervals against *T. absoluta* and *T. urticae*.

MATERIALS AND METHODS

This study was conducted during kharif at the College of Agriculture, Vijayapura, University of Agricultural Sciences, Dharwad, during 2018. The experiment was conducted with eleven treatments and three replications, and the variety Lakshmi (hybrid) transplanted in July and grown following all recommended agronomic practices except for plant protection measures. The insecticides treatments were imposed two times as a spray in the cropping period at vegetative and fruit development stage after observing pest incidence. The treatment details are: spiromesifen 22.9%SC @ 0.5ml/ l (T_1), dicofol 18.5%EC @ 2.5ml/ l (T_2), fenazaquin 10%EC @ 2.0 ml/ l (T_3), propargite 57%EC @ 3.0 ml/ l (T_4), chlorantraniliprole 18.5%SC @ 0.15 ml/ l (T_5), flubendiamide 39.35%SC @ 0.075 (T_6), emamectin benzoate 5%SG 0.20 g/ l (T_7), untreated check (T_8), chlorantraniliprole 18.5%SC @ 0.15 ml/ l followed by spiromesifen 22.9% SC @ 0.5 ml/ l (after one week spray of T_5) (T_9), chlorantraniliprole 18.5%SC @ 0.15 ml/ l followed by fenazaquin 10 % EC @ 2.0 ml/ l (after one week spray of T_5) (T_{10}) and chlorantraniliprole 18.5%SC @ 0.15 ml/ l followed by propargite 57%EC @ 3.0 ml/ l (after one week spray of T_5) (T_{11}). Five plants were randomly selected from each treatment and number of live mines and larvae/ plant was recorded at one day before spray and one, three, five, seven and 15 days after spray. Number of damaged fruits and healthy fruits were selected separately for calculating % fruit damage during harvesting. The % fruit damage by *T. abosoluta* was calculated by using the formula as described by Usman et al. (2012). Observation on the number of active mites/ square inch of leaf area (top, middle and bottom leaves of plant) was taken from five randomly selected plants of each treatment at one day before spray and one, three, five, seven and 15 days after spray.

RESULTS AND DISCUSSION

The number of *T absoluta* larvae/ plant varied from 1.60 to 8.43, with least value being with chlorantraniliprole 18.5%SC @ 0.15 ml/ l followed by propargite 57%C @ 3ml/ l(1.60/ plant); these were statistically on par with chlorantraniliprole 18.5%SC @ 0.15 ml/ l (1.63/ plant), as against untreated check showing maximum (9.61/plant) (Table 1). These results are in line with those of Sapkal et al. (2018) on chlorantraniliprole 18.5%SC, emamectin benzoate 5%SG, spinetoram 11.7%SC and spinosad 45%SC, of which chlorantraniliprole was the most effective. Kandil et al. (2020) observed that emamectin benzoate and chlorantraniliprole were the most superior. The least number of live mines were observed with chlorantraniliprole 18.5%SC @ 0.15 ml/ l (1.36/ plant), followed spiromesifen 22.9 % SC @ 0.5 ml/ l (1.41/ plant) (Table 1). Bassi et al. (2012) reported that chlorantraniliprole (Rynaxypyr) is a novel diamide insecticide with outstanding performance on *T. absoluta* in reduction of number of larvae and live mines. Dilipsundar and Srinivasan (2019) revealed maximum reduction in larval population with chlorantraniliprole 18.5 SC @ 40g a.i./ha (90.35%) followed by spinosad 45 SC @ 73g a.i./ha (87.58%) and flubendiamide 480 SC @ 48g a.i./ha (84.10%). The fruit damage was least in chlorantraniliprole 18.5%SC @ 0.15 ml/ l (2.06/ plant), followed by spiromesifen 22.9%SC @ 0.5 ml/ l (2.37/plant), while it was 24.99/ plant in untreated check (Table 1). Eleonora et al. (2014) reported that on the sixth day larval mortality was 100% for emamectin benzoate, flubendiamide and chlorantraniliprole. Ayalew (2015) revealed that fruit infestation in untreated control was between 54 and 76%, while in plots treated with diamide insecticides (chlorantraniliprole) it was significantly lower with 2–6% followed by spinosyns (spinetoram and spinosad) with 30–35% damage.

The incidence of mites/ square inch was the least in spiromesifen 22.9%SC @ 0.5 ml/ l (1.01/ sq inch) at third day and was on par with fenazaquin 10%EC @ 2ml/ l (1.14/ sq inch), while in untreated check it was 6.42/ vsq inch. Significantly on 15th day reduced mite incidence was observed with chlorantraniliprole 18.5%SC @ 0.15 ml/ l followed by spiromesifen 22.9%SC @ 0.5 ml/ l (1.63/ sq inch) (Table 1). Randhawa et al. (2020) showed that spiromesifen 22.9% @ 500 ml/ ha led to the least mite population (1.41mites/ leaf). Kavya et al. (2015) revealed that spiromesifen (1.05 mites/ leaf) reduced the incidence significantly than any other acaricides. Thus, chlorantraniliprole 18.5%SC @ 0.5ml/ l was superior against both *T. absoluta* and *T. urticae*, followed by flubendiamide 39.35%SC and emamectin benzoate 5% SG. The treatment spiromesifen 22.9% SC @ 0.5 ml/ l was effective in reducing *T. urticae* followed by fenazaquin 10%EC @ 2 ml/ l, propargite 57%EC @ 3ml/ l and dicofol 18.5%EC @ 2.5 ml/ l. The treatment chlorantraniliprole 18.5% SC @ 0.15 ml/ l followed by spiromesifen 22.9% SC @ 0.5 ml/ l was one of the best treatments as a combined approach.

ACKNOWLEDGEMENTS

Authors thank the Dean, college of Agriculture, Vijayapur, Department of Entomology and Department of Agronomy for providing facilities; Basavaraj Awaji, Chinni Prakash, Ganesh and diploma students are acknowledged for their technical and field support.

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Table 1. Efficacy of insecticides against *T. absoluta* and *T. urticae* in tomato

Treatments	No. of *T. absoluta* larvae/ plant*						% fruit damage by *T. absoluta*/ plant^{+}					
	1DBS	1DAS	3DAS	5DAS	7DAS	15DAS	1DBS	1DAS	3DAS	5DAS	7DAS	15DAS
T_1	7.80	7.87	7.97	8.12	8.23	8.43	21.87	22.23	22.49	23.26	24.50	25.23
	(2.88)	(2.89)^{a}	(2.91)^{b}	(2.94)^{b}	(2.96)^{b}	(2.99)^{b}	(27.87)	(28.12)^{ab}	(28.30)^{de}	(28.82)^{cd}	(29.66)^{c}	(30.14)^{c}
T_2	7.67	7.73	7.83	7.93	8.38	8.13	19.63	21.14	20.63	21.58	22.03	22.52
	(2.86)	(2.87)^{a}	(2.89)^{b}	(2.90)^{b}	(2.98)^{b}	(2.94)^{b}	(26.30)	(27.37)^{ab}	(27.01)^{d}	(27.68)^{c}	(27.99)^{b}	(28.33)^{b}
T_3	7.57	7.67	7.77	7.87	8.01	8.10	22.74	23.57	22.24	23.52	24.33	25.73
	(2.84)	(2.86)^{a}	(2.88)^{b}	(2.89)^{b}	(2.92)^{b}	(2.93)^{b}	(28.47)	(29.04)^{bc}	(28.14)^{de}	(29.01)^{cd}	(29.55)^{c}	(30.48)^{cd}
T_4	7.73	7.83	7.93	8.03	8.13	8.23	19.62	21.15	21.72	21.78	22.96	23.61
	(2.87)	(2.89)^{a}	(2.90)^{b}	(2.92)^{b}	(2.94)^{b}	(2.96)^{b}	(26.29)	(27.38)^{ab}	(28.16)^{de}	(28.38)^{cd}	(28.63)^{bc}	(29.07)^{bc}
T_5	7.93	7.10	2.80	1.63	2.30	3.60	21.01	19.84	9.15	2.06	4.41	5.90
	(2.90)	(2.76)^{a}	(1.82)^{a}	(1.46)^{a}	(1.67)^{a}	(2.02)^{a}	(27.27)	(26.45)^{a}	(17.59)^{a}	(8.54)^{a}	(12.12)^{a}	(16.14)^{a}
T_6	8.03	7.17	2.90	1.73	2.43	3.83	23.38	21.14	11.05	2.72	4.69	6.72
	(2.92)	(2.77)^{a}	(1.84)^{a}	(1.49)^{a}	(1.71)^{a}	(2.08)^{a}	(28.83)	(27.37)^{ab}	(19.41)^{bc}	(9.61)^{ab}	(12.50)^{a}	(15.02)^{a}
T_7	8.14	7.27	3.07	2.00	2.60	3.90	22.07	22.68	11.06	3.24	5.06	7.06
	(2.94)	(2.79)^{a}	(1.89)^{a}	(1.58)^{a}	(1.76)^{a}	(2.10)^{a}	(28.02)	(26.99)^{ab}	(20.79)^{c}	(10.13)^{b}	(13.25)^{a}	(15.39)^{a}
T_8	7.80	8.20	8.86	9.30	9.42	9.61	23.42	23.85	23.93	24.66	25.17	24.99
	(2.88)	(2.95)^{a}	(3.06)^{b}	(3.13)^{b}	(3.15)^{c}	(3.18)^{c}	(30.06)	(30.32)^{c}	(29.29)^{ef}	(29.66)^{de}	(30.11)^{cd}	(32.91)^{d}
T_9	7.70	7.13	3.00	1.80	2.20	3.57	24.22	22.39	10.81	2.37	4.45	6.61
	(2.86)	(2.76)^{a}	(1.87)^{a}	(1.52)^{a}	(1.64)^{a}	(2.02)^{a}	(29.48)	(26.95)^{a}	(19.52)^{bc}	(8.38)^{a}	(12.17)^{a}	(15.47)^{a}
T_{10}	7.93	7.17	2.90	1.73	2.30	3.70	25.04	20.02	10.51	2.60	4.53	6.65
	(2.90)	(2.77)^{a}	(1.84)^{a}	(1.49)^{a}	(1.67)^{a}	(2.05)^{a}	(29.11)	(26.58)^{a}	(18.92)^{ab}	(9.28)^{a}	(12.90)^{a}	(14.94)^{a}
T_{11}	7.73	7.00	2.96	1.60	2.20	3.77	22.35	20.06	10.14	2.61	4.52	6.69
	(2.87)	(2.74)^{a}	(1.86)^{a}	(1.45)^{a}	(1.64)^{a}	(2.07)^{a}	(28.21)	(26.60)^{a}	(18.56)^{ab}	(9.30)^{a}	(12.28)^{a}	(14.98)^{a}
S.Em.±		0.07	0.06	0.05	0.05	0.06		0.69	0.59	0.52	0.55	0.59
CD (p=0.05)	NS	0.21	0.17	0.16	0.15	0.17	NS	2.04	1.73	1.53	1.61	1.74
CV (%)		12.92	12.67	13.23	11.93	12.26		12.98	12.81	14.57	13.82	13.74
Treatments	No. of live mines of *T. absoluta* larvae/ plant						No. of mites/ square inch of leaf area					
	1DBS	1DAS	3DAS	5DAS	7DAS	15DAS	1DBS	1DAS	3DAS	5DAS	7DAS	15DAS
T_1	6.37	6.48	6.56	6.67	6.75	6.86	5.77	3.63	1.01	1.27	2.03	5.70
	(2.62)	(2.64)^{bc}	(2.66)^{bc}	(2.68)^{b}	(2.69)^{b}	(2.71)^{b}	(2.50)	(2.03)^{a}	(1.23)^{b}	(1.33)^{b}	(1.59)^{b}	(2.49)^{edcb}
T_2	6.79	6.30	6.41	6.50	6.60	6.69	5.40	4.65	1.40	1.57	2.46	5.53
	(2.70)	(2.61)^{bc}	(2.63)^{b}	(2.65)^{b}	(2.66)^{b}	(2.68)^{b}	(2.43)	(2.27)^{dcba}	(1.38)^{b}	(1.44)^{b}	(1.72)^{b}	(2.46)^{dcb}
T_3	6.23	6.33	6.43	6.52	6.63	6.73	4.99	4.05	1.14	1.32	2.12	5.09
	(2.59)	(2.61)^{bc}	(2.63)^{b}	(2.65)^{b}	(2.67)^{b}	(2.69)^{b}	(2.34)	(2.13)^{ba}	(1.28)^{b}	(1.35)^{b}	(1.62)^{b}	(2.36)^{b}
T_4	6.50	6.60	6.70	6.80	6.90	7.00	5.26	4.43	1.24	1.43	2.29	5.43
	(2.65)	(2.66)^{c}	(2.68)^{bc}	(2.70)^{b}	(2.72)^{b}	(2.74)^{b}	(2.40)	(2.22)^{cba}	(1.32)^{b}	(1.39)^{b}	(1.67)^{b}	(2.44)^{cb}
T_5	6.31	5.20	2.50	1.36	2.70	2.93	4.86	5.16	5.36	5.65	5.85	6.68
	(2.61)	(2.39)^{a}	(1.73)^{a}	(1.37)^{a}	(1.79)a	(1.85)^{a}	(2.32)	(2.38)^{dcb}	(2.42)^{dc}	(2.48)^{c}	(2.58)^{c}	(2.68)^{e}
T_6	6.47	5.30	2.60	1.46	2.70	2.83	5.27	5.55	5.85	6.05	6.21	6.31
	(2.64)	(2.41)^{a}	(1.76)^{a}	(1.40)^{a}	(1.79)^{a}	(1.83)^{a}	(2.40)	(2.46)^{dcb}	(2.52)^{dc}	(2.56)^{dc}	(2.59)^{dc}	(2.61)^{edc}
T_7	6.27	5.38	2.70	1.56	2.92	3.03	5.13	5.70	5.95	6.26	6.36	6.52
	(2.60)	(2.43)^{a}	(1.79)^{a}	(1.44)^{a}	(1.85)^{a}	(1.88)^{a}	(2.37)	(2.49)^{dc}	(2.54)^{dc}	(2.60)^{dc}	(2.62)^{dc}	(2.65)^{ed}
T_8	6.43	7.06	7.57	7.79	8.03	8.38	5.30	6.16	6.42	6.68	6.90	6.68
	(2.63)	(2.75)^{c}	(2.84)^{c}	(2.88)^{c}	(2.92)^{c}	(2.98)^{c}	(2.41)	(2.58)^{d}	(2.63)^{d}	(2.68)^{d}	(2.72)^{d}	(2.68)^{e}
T_9	6.37	5.24	2.55	1.41	2.75	2.80	4.93	5.85	6.05	6.16	6.52	1.63
	(2.62)	(2.40)^{a}	(1.75)^{a}	(1.38)^{a}	(1.80)^{a}	(1.82)^{a}	(2.33)	(2.52)^{dc}	(2.56)^{dc}	(2.58)^{dc}	(2.65)^{dc}	(1.46)^{a}
T_{10}	6.68	5.65	2.46	1.44	2.78	2.92	5.50	5.65	6.16	6.31	6.63	1.87
	(2.68)	(2.48)^{bc}	(1.72)^{a}	(1.39)^{a}	(1.81)^{a}	(1.85)^{a}	(2.45)	(2.48)^{dc}	(2.58)^{dc}	(2.61)^{dc}	(2.67)^{dc}	(1.54)^{a}
T_{11}	6.90	5.30	2.59	1.46	2.80	3.03	5.70	5.80	6.00	6.36	6.47	1.93
	(2.72)	(2.41)^{a}	(1.76)^{a}	(1.40)^{a}	(1.82)^{a}	(1.88)^{a}	(2.49)	(2.51)^{dc}	(2.55)^{dc}	(2.62)^{dc}	(2.64)^{dc}	(1.56)^{a}
SEm.±		0.05	0.06	0.05	0.06	0.06		0.10	0.05	0.05	0.05	0.06
CD (p=0.05)	NS	0.15	0.18	0.15	0.17	0.18	NS	0.28	0.15	0.14	0.15	0.17
CV (%)		10.58	13.93	13.86	13.64	14.23		11.97	12.63	12.52	12.79	13.94

DBS-Day before spray; DAS-Days after spary; *Figures in parentheses $\sqrt{(x+0.5)}$ transformed; $^{+}$Figures in parentheses arcsine transformed; Mean followed by similar alphabets in the column do not differ significantly at p=0.05% by DMRT

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(Manuscript Received: November, 2021; Revised: March, 2022;
Accepted: March, 2022; Online Published: April, 2022)
Online First in www.entosocindia.org and indianentomology.org Ref. No. e21247