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EVALUATION OF DIFFERENT TRAPS FOR MANAGEMENT OF TOMATO PINWORM, *Phthorimaea absoluta* (Meyrick) (LEPIDOPTERA: GELECHIIDAE) IN SOUTHERN DRY ZONE OF KARNATAKA

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ABSTRACT

The research on the evaluation of traps for managing *Phthorimaea absoluta* (Meyrick) was conducted at the College of Agriculture, Karekere, Hassan, during *Rabi* 2023-24. Among the traps tested, Delta sticky traps and yellow sticky trap proved most effective, with an average of 194.15 and 173.78 moths/trap/week demonstrated significant superiority in capturing adult moths and controlling larval populations, along with reducing foliage and fruit infestation in field conditions. This suggests that Delta sticky trap with TLM lure are highly economical, feasible, and easily adoptable by farmers.
***Keywords*: Delta sticky traps, yellow sticky trap, *Phthorimaea absoluta,* tomato pinworm.

Introduction

Phthorimaea absoluta (Meyrick) (Lepidoptera: Gelechiidae), commonly known as the tomato leaf miner or pinworm, is an invasive, oligophagous pest primarily affecting tomatoes but also other solanaceous crops. Globally, tomatoes are grown in 4.917 million hectares, producing 18.61 million metric tons. In India, tomatoes are grown in 843,000 hectares, with an annual production of 20.694 million metric tons (FAO, 2022), faces significant production challenges due to pests and diseases. *P. absoluta* has become a major pest in India, having been a dominant threat in South America since the 1960's (Garcia and Espul, 1982), and is native to this region (Urbaneja *et al*., 2013). The pest was first recorded in India in Maharashtra in October 2014 (Shashank *et al*., 2015) and later in Karnataka at ICAR-Indian Institute of Horticultural Research (ICAR-IIHR), Hessaraghatta, Bengaluru, during the 2014 *Rabi*season (Sridhar *et al*., 2014). *P. absoluta* causes severe yield and fruit quality reductions, with losses reaching up to 100% in both greenhouse and open-field conditions (Shashank *et al*., 2015; Daniel *et al*., 2017). The larvae damage various parts of the plant, including leaves, buds, stems, and fruits. Fruit rot often follows as secondary pathogens invade the damaged fruits (Daniel *et al*., 2017). Tomatoes are now widely cultivated around the globe, including by small and marginal farmers. Due to the widespread presence and significant damage caused by *P. absoluta* (tomato pinworm), it is essential to develop effective pest management strategies for all growing seasons. Hence, this study aims to examine the different sex pheromone traps for management of *P. absoluta*.

Materials and Methods

Experimental site and design

The present study was carried out under field conditions during *Rabi* 2023-24 at the College of Agriculture, Karekere, Hassan, University of Agricultural Sciences, Bangalore (UASB), located at 12° 58' 18" North latitude and 76° 16' 13" East longitude, to assess the effectiveness of different types of traps in capturing *P. absoluta* moths in tomatoes.

Alankar hybrid tomato plants were used, with a spacing of 90 cm x 60 cm. The experiment was designed in a Randomized Block Design (RCBD) with seven treatments, each replicated three times. The details of the treatments are provided in Table 1. Sex pheromone traps were installed 30 days after transplanting, and Tomato Leaf Miner (TLM) lures were replaced every 15 days to ensure accurate results. Moth counts were recorded weekly until the crop harvest (Anon., 2017b).

Observations were made on the number of moths caught per week, as well as leaf and fruit damage, from five randomly selected and tagged plants. The percentage of leaf and fruit damage was calculated. Treatment counts were conducted at one, three, seven, and fourteen days after treatment.

Leaf Damage: The number of infested leaves was counted weekly and expressed as the percentage of leaf damage

$$\text{Leaf damage}\,(\%) = \frac{\text{No. of leaves infested per plant}}{\text{Total number of leaves per plant}} \times 100$$

Fruit Damage: Similarly, fruit damage was assessed by counting the number of damaged fruits weekly and expressing it as a percentage of fruit damage

$$\text{Fruit damage}\,(\%) = \frac{\text{No. of fruits infested per plant}}{\text{Total number of fruits per plant}} \times 100$$

Table 1: List of traps tested against tomato pinworm, *P. absoluta*

Tr. No.	Treatment details	No. of traps/ha
T_1	Deltasticky trap with TLM lure	40
T_2	water trap with TLM lure	40
T_3	Yellow sticky trap with TLM lure	40
T_4	Blue sticky trap with TLM lure	40
T_5	Water pan with TLM lure	40
T_6	Yellow water pan with TLM lure	40
T_7	Control	-

Thus, the data on the number of moths per trap per week were subjected to square root transformation, while the data on the percentage of foliage and fruit damage were transformed using the Arc sine transformation. The transformed data were then analyzed using ANOVA (Gomez and Gomez, 1984; Hoshmand, 1988), and the means were compared using Tukey's HSD (Tukey, 1965).

Results and Discussion

Influence of different traps on attracting *P. absoluta* moths

All the traps tested were effective in capturing *P. absoluta* moths, with the delta sticky trap proving to be the most efficient, capturing an average of 194.15 moths per week. The yellow sticky trap was the second most effective, capturing 173.78 moths per week. The blue sticky trap, yellow water pan, and water pan captured 144.77, 109.80, and 97.07 moths per week, respectively. The least effective was the water trap with pheromone, capturing only 52.46 moths per week (Table 2). Six weeks after installation, the delta sticky trap (244.30 moths/week) continued to outperform the other traps, with the yellow sticky trap capturing 218.49 moths per week. The water trap, on the other hand, recorded only 58.64 moths per week. During the fruiting stage, in the seventh standard week, the delta sticky trap (90.71 moths/week) remained the most effective, while the water trap captured just 29.95 moths per week. By the eighth and ninth standard weeks, moth catches were very low, ranging from 0.29 to 24.27 moths per week.

Overall, the delta sticky trap consistently captured the highest number of moths, with an average of 194.15 moths per week, far surpassing the other traps. The water trap with pheromone captured the fewest, with an average of just 52.46 moths per week (Table 2).

Impact of different traps on per cent foliar damage by *P. absoluta*

The study evaluated the effectiveness of different traps in reducing foliage damage caused by *P. absoluta*, comparing them to the control group from early growth through to harvest. Initially, foliage damage ranged from 6.67% to 10.67%. One week after treatment, the delta sticky trap caused the least damage, at 7.40%, followed by the yellow sticky trap (8.19%), blue sticky trap (11.85%), and yellow water pan (12.43%). The water trap had the highest damage at 18.20%, while the control group showed 51.00% damage.

Seven weeks after treatment, during the flowering and fruiting stages, the delta sticky trap (50.91%) and yellow sticky trap (56.81%) continued to show the least damage, while the control (88.00%) and water trap (79.65%) experienced the most damage. By eight weeks, the delta sticky trap (49.74%) and yellow sticky trap (57.28%) remained the most effective, with the control (89.00%) and water trap (69.65%) showing the highest levels of damage. At the tenth week, the delta sticky trap (75.54%) and yellow sticky trap (79.40%) still exhibited the least damage, whereas the control (93.45%) and water trap (89.31%) had the highest damage.

Overall, the delta sticky trap was the most effective, with an average foliage damage of 38.18%. The yellow sticky trap followed closely with 41.78%, and the blue sticky trap caused 48.48% damage. The control group had an average damage of 71.82%, while the water trap resulted in 57.86% damage (Table 3).

Table 2 : Efficiency of sex pheromone traps on moths catches of *P. absoluta* on tomato during *Rabi* 2023-24.

Tr. No.	*Number of moths/ trap at different standard weeks										Mean
	SW52	**SW1**	**SW2**	**SW3**	**SW4**	**SW5**	**SW6**	**SW7**	**SW8**	**SW9**	
T1	272.09 (17.00)^{a}	317.36 (18.31)^{a}	269.22 (16.91)^{a}	293.99 (17.65)^{a}	290.16 (17.53)^{a}	244.30 (16.13)^{a}	137.86 (12.24)^{a}	90.71 (10.02)^{a}	24.27 (5.43)^{a}	1.50 (1.72)^{a}	194.15 (14.43)^{a}
T2	54.66 (7.89)^{e}	75.06 (9.16)^{e}	71.44 (8.95)^{e}	96.36 (10.32)^{f}	70.21 (8.88)^{f}	58.64 (8.16)^{f}	55.31 (7.94)^{e}	29.95 (5.97)^{d}	12.70 (4.06)^{d}	0.29 (1.04)^{f}	52.46 (7.74)^{f}
T3	211.09 (15.03)^{b}	286.31 (17.42)^{b}	265.69 (16.80)^{a}	283.20 (17.33)^{b}	272.97 (17.02)^{b}	218.49 (15.28)^{b}	118.00 (11.36)^{b}	58.64 (8.16)^{b}	22.15 (5.21)^{b}	1.25 (1.62)^{b}	173.78 (13.68)^{b}
T4	166.88 (13.42)^{c}	222.69 (15.42)^{c}	210.96 (15.02)^{b}	240.51 (16.01)^{c}	216.68 (15.22)^{c}	196.95 (14.53)^{c}	117.70 (11.35)^{b}	57.32 (8.07)^{b}	16.79 (4.60)^{c}	1.17 (1.58)^{c}	144.77 (12.53)^{c}
T5	112.87 (11.12)^{d}	157.04 (13.03)^{d}	151.13 (12.79)^{d}	167.73 (13.45)^{e}	146.73 (12.61)^{e}	114.32 (11.19)^{e}	68.48 (8.78)^{d}	40.21 (6.84)^{c}	11.74 (3.93)^{e}	0.49 (1.20)^{e}	97.07 (10.35)^{e}
T6	120.95 (11.50)^{d}	166.54 (13.41)^{d}	166.02 (13.39)^{c}	185.08 (14.10)^{d}	166.26 (13.39)^{d}	148.76 (12.70)^{d}	90.01 (9.99)^{c}	41.02 (6.90)^{c}	12.64 (4.06)^{d}	0.71 (1.34)^{d}	109.80 (10.98)^{d}
T7	0.00 (0.50)^{f}	0.00 (0.50)^{f}	0.00 (0.50)^{f}	0.00 (0.50)^{g}	0.00 (0.50)^{g}	0.00 (0.50)^{g}	0.00 (0.50)^{f}	0.00 (0.50)^{e}	0.00 (0.50)^{f}	0.00 (0.50)^{g}	0.00 (0.50)^{g}
S.E.M.	2.70	3.89	1.32	2.93	2.12	2.76	1.35	0.95	0.15	0.01	1.83
C.D. 5%	8.32	11.99	4.08	9.02	6.54	8.50	4.15	2.94	0.48	0.04	5.64

SW = Standard week, Figures in parenthesis indicate transformed values,
Means followed by the same alphabet (s) are in a column not significantly different (P=0.05) from each other

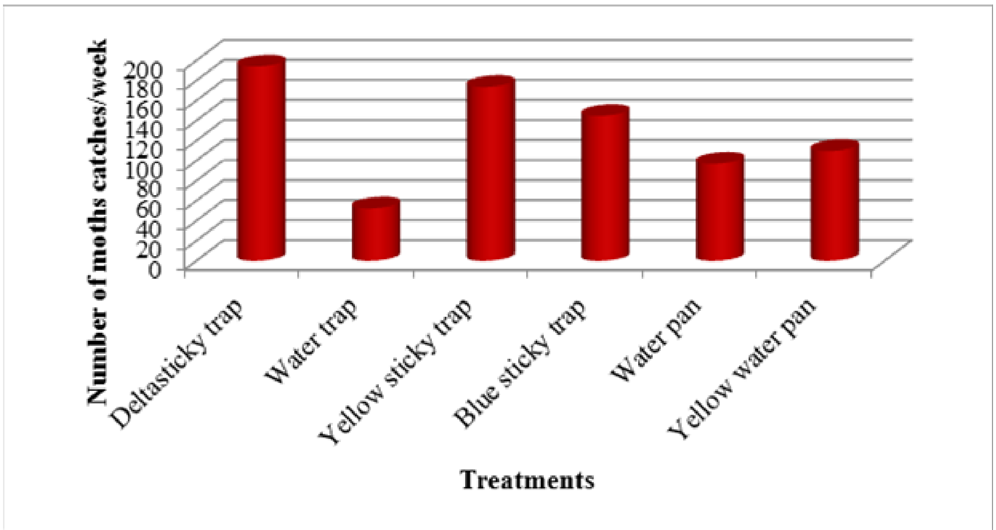

Fig. 1 : Trap catches of *Phthorimaea absoluta* moths on different type of pheromone traps

Table 3 : Efficiency of sex pheromone traps on foliar damage by *Phthorimaea absoluta*on tomato during *Rabi* 2023-24.

Tr. No.	Foliar damage % by *P. absoluta* at different standard week											Mean
	DBT	**SW52**	**SW1**	**SW2**	**SW3**	**SW4**	**SW5**	**SW6**	**SW7**	**SW8**	**SW9**	
T1	6.83 (15.15)^{e}	7.40 (15.78)^{e}	12.01 (20.28)^{f}	19.91 (26.50)^{d}	30.98 (33.82)^{e}	45.15 (42.22)^{f}	47.98 (43.84)^{e}	50.91 (45.52)^{f}	49.74 (44.85)^{e}	73.59 (59.08)^{d}	75.54 (60.36)^{d}	38.18 (38.17)^{f}
T2	10.79 (19.18)^{b}	18.20 (25.26)^{b}	26.97 (31.29)^{b}	29.40 (32.84)^{b}	55.16 (47.96)^{b}	79.93 (63.38)^{a}	74.89 (59.93)^{b}	79.65 (63.18)^{b}	83.34 (65.91)^{b}	88.78 (70.43)^{a}	89.31 (70.92)^{b}	57.86 (49.52)^{b}
T3	9.29 (17.74)^{d}	8.19 (16.63)^{e}	15.41 (23.12)^{e}	23.16 (28.76)^{c}	32.44 (34.72)^{e}	47.42 (43.52)^{e}	54.90 (47.81)^{d}	56.81 (48.91)^{e}	57.28 (49.18)^{d}	75.24 (60.16)^{cd}	79.40 (63.01)^{d}	41.78 (40.27)^{e}
T4	9.39 (17.84)^{d}	11.85 (20.13)^{d}	16.40 (23.89)^{de}	25.04 (30.02)^{c}	41.75 (40.25)^{d}	57.34 (49.22)^{d}	65.47 (54.01)^{c}	73.01 (58.70)^{d}	69.65 (56.57)^{c}	79.61 (63.16)^{bc}	83.84 (66.30)^{c}	48.48 (44.13)^{d}
T5	10.77 (19.16)^{b}	15.34 (23.06)^{c}	20.62 (27.01)^{c}	29.35 (32.80)^{b}	45.02 (42.14)^{c}	65.30 (53.91)^{b}	73.82 (59.23)^{b}	77.35 (61.58)^{bc}	82.78 (65.48)^{b}	83.81 (66.27)^{b}	89.28 (70.89)^{b}	53.95 (47.26)^{c}

T6	10.23 (18.65)^{c}	12.43 (20.64)^{d}	17.33 (24.60)^{d}	27.81 (31.83)^{b}	43.91 (41.50)^{cd}	63.02 (52.55)^{c}	72.47 (58.35)^{b}	73.82 (59.22)^{cd}	81.77 (64.72)^{b}	83.77 (66.24)^{b}	84.24 (66.61)^{c}	51.89 (46.08)^{c}
T7	20.00 (26.57)^{a}	51.00 (45.57)^{a}	60.00 (50.77)^{a}	63.00 (52.54)^{a}	68.00 (55.55)^{a}	80.16 (63.55)^{a}	87.00 (68.87)^{a}	88.00 (69.73)^{a}	89.00 (70.63)^{a}	90.37 (71.92)^{a}	93.45 (75.18)^{a}	71.82 (57.94)^{a}
S.E. M.	0.13	0.43	0.44	0.72	0.77	0.62	0.87	1.26	1.16	1.42	1.30	0.68
C.D. 5%	0.39	1.32	1.35	2.22	2.38	1.91	2.67	3.90	3.58	4.38	4.00	2.08

DBT = Day before treatment (trap installation), SW = Standard week, Figures in parenthesis indicate transformed values, Means followed by the same alphabet (s) are in a column not significantly different (P=0.05) from each other

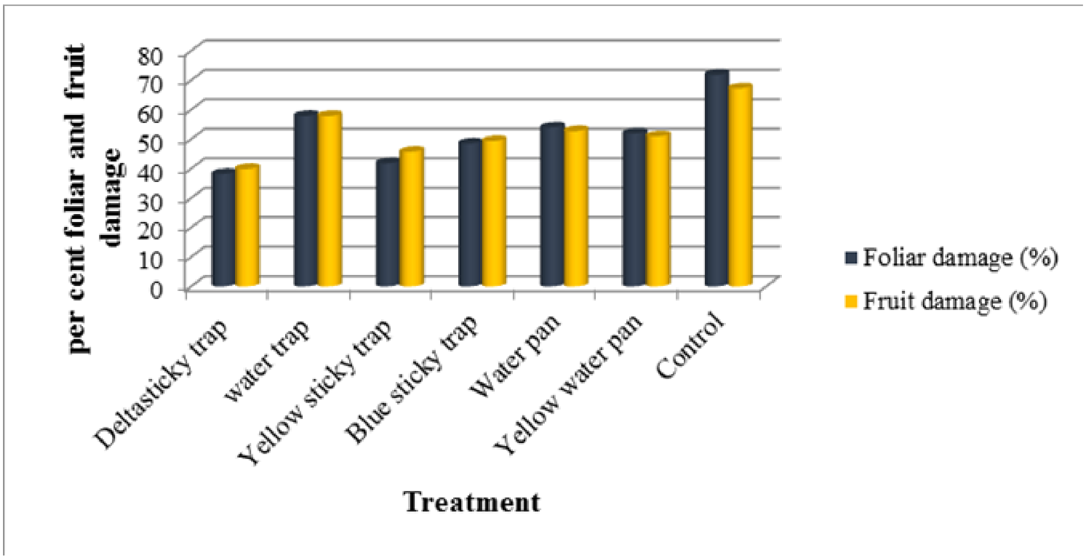

Fig. 2 : Effect of different types of traps on fruit damage and foliar damage by tomato pinworm

Table 4 : Efficiency of sex pheromone traps on fruit damage by *Phthorimaea absoluta* on tomato during *Rabi* 2023-24.

Tr. No.	**Fruit damage % by *P. absoluta* at different standard week**								**Mean**
	SW2	**SW3**	**SW4**	**SW5**	**SW6**	**SW7**	**SW8**	**SW9**	
T1	6.73 (15.04)^{f}	21.17 (27.39)^{f}	29.94 (33.17)^{f}	36.41 (37.11)^{f}	44.74 (41.98)^{f}	54.02 (47.31)^{e}	54.25 (47.44)^{e}	71.87 (57.97)^{c}	39.89 (39.17)^{f}
T2	15.63 (23.29)^{b}	30.33 (33.42)^{b}	47.52 (43.58)^{b}	56.11 (48.51)^{b}	69.00 (56.17)^{b}	72.72 (58.51)^{b}	78.85 (62.62)^{b}	92.62 (74.24)^{a}	57.85 (49.51)^{b}
T3	9.39 (17.84)^{e}	24.26 (29.51)^{e}	30.91 (33.78)^{f}	45.77 (42.57)^{e}	57.24 (49.16)^{e}	64.26 (53.29)^{d}	60.07 (50.81)^{d}	73.83 (59.23)^{c}	45.72 (42.54)^{e}
T4	11.24 (19.59)^{d}	26.19 (30.78)^{d}	32.78 (34.93)^{e}	49.50 (44.71)^{d}	61.23 (51.49)^{d}	69.09 (56.22)^{c}	70.28 (56.96)^{c}	74.46 (59.64)^{bc}	49.35 (44.63)^{d}
T5	12.63 (20.82)^{c}	27.87 (31.87)^{c}	42.74 (40.83)^{c}	53.99 (47.29)^{bc}	64.24 (53.27)^{c}	71.55 (57.77)^{bc}	71.45 (57.70)^{c}	77.31 (61.55)^{b}	52.72 (46.56)^{c}
T6	12.16 (20.41)^{c}	26.78 (31.16)^{cd}	37.92 (38.01)^{d}	51.31 (45.75)^{cd}	62.73 (52.37)^{cd}	71.32 (57.62)^{bc}	70.58 (57.15)^{c}	74.78 (59.85)^{bc}	50.95 (45.54)^{d}
T7	21.19 (27.41)^{a}	40.73 (39.66)^{a}	56.69 (48.85)^{a}	73.51 (59.03)^{a}	80.47 (63.77)^{a}	84.99 (67.20)^{a}	87.11 (68.96)^{a}	92.96 (74.61)^{a}	67.21 (55.06)^{a}
S.E.M.	0.22	0.48	0.41	1.01	0.78	0.91	1.32	1.04	0.54
C.D. 5%	0.66	1.48	1.27	3.11	2.40	2.79	4.06	3.21	1.65

SW = Standard week, Figures in parenthesis indicate transformed values,
Means followed by the same alphabet (s) are in a column not significantly different (P=0.05) from each other

Impact of different traps on per cent fruit damage by *P. absoluta*

The study assessed the impact of different traps on fruit damage caused by *P. absoluta*. In the first week, delta sticky trap had the lowest fruit damage at 6.73%, followed by yellow sticky trap (9.39%) and blue sticky trap (11.24%). The control showed the highest damage at 21.19%.

At four weeks, delta sticky trap recorded the least damage (36.41%), followed by yellow sticky trap (45.77%) and blue sticky trap (49.50%). Control (73.51%) and water trap (56.11%) had the most damage. By the fifth week, delta sticky trap showed 44.74% damage, significantly lower than yellow sticky trap (57.24%) and blue sticky trap (61.23%). Control (69.00%) and water trap (80.47%) had the highest damage.

At week eight, delta sticky trap (71.87%) and yellow sticky trap (73.83%) had the least damage, while the other traps showed damage ranging from 74.46% to 92.96%. Overall, delta sticky trap consistently recorded the least average fruit damage at 39.89%, significantly better than yellow sticky trap (45.72%) and blue sticky trap (49.35%). Control (67.21%) and water trap (57.85%) had the highest damage levels, with none of the treatments achieving complete control over fruit damage (Table 4).

The present findings are consistent with Taha*et al.* (2012), who reported that red delta and water pan traps captured 1.58 and 1.52 times more male moths, respectively, compared to yellow traps of the same design. Taha *et al.* (2014) further demonstrated that delta baited sex pheromone traps caught the highest number of male moths (269.67). Kumari *et al.* (2015) recommended using only four pheromone traps per acre to monitor *T. absoluta*. Retta and Berhe (2015) supported pheromone traps as the most reliable tool for detecting the presence of *T. absoluta*. Sridhar and Kumaran (2018) noted that 60 W incandescent yellow bulbs, along with yellow and bluish-white traps, were effective in attracting moths (Table 4).

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