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Monitoring of tomato fruit borer (*Helicoverpa armigera*) in relation to abiotic factors in Udaipur

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Abstract
Helicoverpa armigera is the most destructive pest of many crops which severely affects both the quality and quantity of produce. Excessive dependence on insecticides has led to the problem of pest resistance and toxic residues. Developing an efficient monitoring system to know the population dynamics of the pest to keep constant vigilance is important. The adult population was monitored with the light and pheromone traps in Horticulture farm, Rajasthan College of Agriculture, MPUAT, Udaipur. The adult moth activities were first noticed from the 33rd SMW. The mean trap catches were initially low (4.5 per pheromone traps and 14 per light trap) which increased gradually and attained the peak (20.5 per pheromone traps and 95 per light trap) during mid-October (41st and 42nd SMW). The pheromone and light trap catches exhibited a negatively non-significant correlation with mean temperature (r = -0.008 and r = -0.0004), while negatively significant correlation with relative humidity (r = -0.658* and r = -0.751*) and rainfall (r = -0.567* and r = -0.632*).

Keywords: *Helicoverpa armigera*, light traps, monitoring, pheromone traps

Introduction
Owing to its immense commerciality, nutritive values and wide range of climatic adaptability, the tomato crop has attained tremendous popularity in the world. It is regarded as one of the foremost remunerative crops among vegetables. In 2019, India produced about 19.00 million tonnes of tomatoes from an area of 0.781 million ha with an average productivity of 24.33 tonnes /ha [1]. Productivity of tomatoes in Rajasthan (4.9 tonnes/ha) is least in the country with the production of 88.73 thousand tonnes from an area of 0.018 million ha [2]. This low productivity can be attributed to various abiotic and biotic factors. Insect pests are the major biotic factors hindering the tomato production.

The fruit borer, *H. armigera* is the most destructive pest of tomato causing quantitative and qualitative yield losses [3]. Both the production and productivity are severely affected by this pest. Physiological features like nocturnal habit, high mobility and fecundity, overlapping generations, ravenous feeding habits, migration, tendency for acquiring resistance against wide range of insecticides, direct attack on fruiting structures and multivoltine nature contribute for its severity in different situations [4]. Young larvae feed exclusively on foliage, flower buds and flowers damaging all the growth stages of crop; while, the late instars bore into fruits and render them unmarketable.

To control the notorious pest, different synthetic pesticides have been suggested due to their easy availability and applicability, which have resulted in adverse effects like toxicity to non-target organisms (predators, parasitoids and pollinators), development of insecticide resistance, pest resurgence, toxic residues, environmental pollution and health hazards etc, besides the increased cost of cultivation per unit area. Quicker control strategy for the pest and quests for getting higher yields led to indiscriminate use of pesticides. For effective management of the pest, it is obligatory to know population dynamics of the pest and to have a constant vigil on the pest under agroclimatic conditions prevailing in a particular area. Hence, attempt was made to monitor and study the seasonal incidence of *H. armigera* with pheromone traps and light trap in relation to abiotic factors.

Materials and Methods
The present study was conducted at Horticultural farm, Rajasthan College of Agriculture, Udaipur. The experiment was carried out during *kharif* 2018. Locally available tomato hybrid 'USM KAREENA' was raised in different locations of the horticulture farm. Pheromone and a

light trap were installed in the horticulture farm to monitor the adult moths in the tomato crop. The traps were installed from the 33rd SMW and kept until the harvesting of the tomato crop. The pheromone lures were changed periodically at 15 days interval. The trapped moths were removed and counted regularly from the installations. The pheromone traps were set at 1m above the crop height to trap maximum number of male moths. The data on number of catches were pooled and total number of moths trapped per week was worked out. The meteorological data was subjected to simple correlation analysis with trap catches to know the influence of abiotic factors on adult moth activity.

Fig 1: Pheromone and light trap installations used in monitoring of *H. armigera* in Horticulture farm during *kharif* 2018

Results and discussion

The data pertaining to adult moth catches were recorded and presented in Table 1 and Fig 2. The data revealed that adult moth catches in the pheromone traps initiated within the first week of installation (33rd SMW). The catches in the pheromone traps were initially low and gradually reached the peak (mean 20.50 moths/ trap) in the second week of October (41st SMW). The second peak was observed in the 44th SMW, with a mean population of 17 moths/ trap. The moth catches then gradually decreased and reached the lowest (8.50 moths/ trap) in the 48th SMW. The adult moth activity and catches in light trap continued throughout the crop season. The catches were initially low (14 moths/ trap) in 33rd SMW, thereafter gradually increased and reached the peak (95 moths/ trap) in the third week of October (42nd SMW) and then gradually declined and reached the mean of 40 moths/ trap in 49th SMW. The moth catches showed non-significantly negative correlation with atmospheric temperature (r = -0.008 and r = -0.0004), while significantly negative correlation with relative humidity (r = -0.658* and r = -0.75*) and rainfall (r = -0.567* and r = -0.632*) for pheromone and light traps respectively.

Since meagre research has been conducted on trap catches in tomato during *kharif*, the results have been discussed with trap catches in other crops during the *kharif* season. The results of present study are in accordance with the findings of [5], who through the pooled data (2001-2019) observed two peaks in pheromone trap catches of *Helicoverpa armigera* during the first fortnight of October and the trap catches were negative and significantly correlated with relative humidity and rainfall. Similarly, [6] observed highest pheromone trap catches (23.86 moths/trap) in 40th SMW, while maximum light trap catches (127.67 moths/ trap) in 47th SMW. The pheromone and light trap catches were negatively correlated with temperature, relative humidity and rainfall [7] reported that pheromone trap catches showed two peaks (16.8 and 19.5 moths/ trap) during 41 – 45th SMW in all the modules. The present results of two peaks in pheromone trap catches during the fruiting stage is supported by the similar findings of [8], who observed two peaks in pheromone trap catches during the fruiting stage of the tomato crop. The present findings corroborate with that of [9] who reported that the pheromone trap catches had negative non-significant correlation with rainfall (r = -0.237) and temperature (r = - 0.338), while significant correlation with relative humidity (r = - 0.491). The present results are partially in conformity with [10] who reported negatively significant correlation (r = - 0.744) between temperature and pheromone trap catches, while non-significant correlation (r = - 0.232) between relative humidity and trap catches.

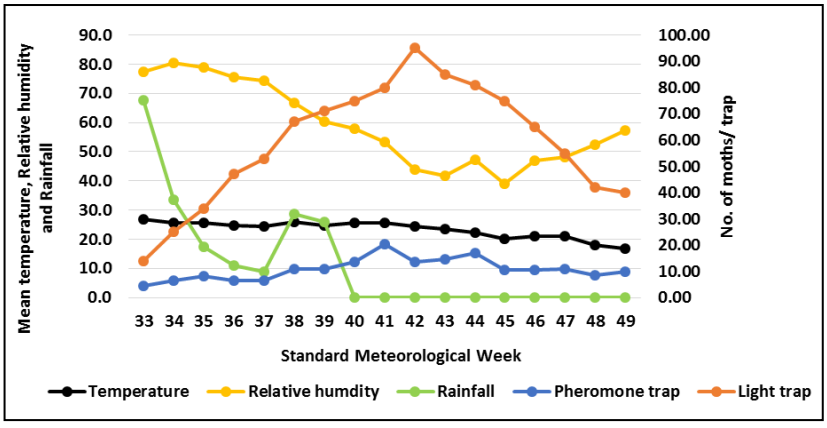

Fig 2: Pheromone and light trap catches of *H. armigera* in relation to abiotic factors during *kharif* 2018

Table 1: Monitoring of *H. armigera* with pheromone and light traps during *kharif* 2018

Standard meteorological weeks (SMW)	Abiotic factors			Adult moth catches / trap/ week	
	Mean Temp (º C)	Mean Relative Humidity (%)	Total rainfall (mm)	Pheromone trap (mean)	Light trap
33	26.8	77.4	67.6	4.50	14
34	25.5	80.4	33.6	6.50	25
35	25.5	78.9	17.4	8.00	34
36	24.6	75.4	11.0	6.50	47
37	24.4	74.2	8.8	6.50	53
38	26.0	66.9	28.8	11.00	67
39	24.7	60.4	25.8	11.00	71
40	25.7	57.9	0.0	13.50	75
41	25.7	53.3	0.0	20.50	80
42	24.5	43.9	0.0	13.50	95
43	23.6	41.9	0.0	14.50	85
44	22.3	47.4	0.0	17.00	81
45	20.2	39.1	0.0	10.50	75
46	21.2	46.9	0.0	10.50	65
47	21.0	48.1	0.0	11.00	55
48	17.9	52.4	0.0	8.50	42
49	16.9	57.2	0.0	10.00	40
Seasonal mean	23.3	58.9	11.4	10.79	59.06
Coefficient of correlation (r) for moth catches and Mean temperature				-0.008	-0.0004
Coefficient of correlation (r) for moth catches and relative humidity				-0.658*	-0.751*
Coefficient of correlation (r) for moth catches and total rainfall.				-0.567*	-0.632*

* Significant at 5% level of significance.

Conclusion

Results on monitoring through light and pheromone traps indicated that the seasonal activity of fruit borer continued throughout the crop period. Two peaks were observed during the crop period indicating that the climatic conditions during October- November are ideal for the pest and it coincides with the peak fruiting stage of the crop. The trap catches were negatively correlated with rainfall and humidity which may be due to unfavourable conditions for viability, dispensability and persistence of the lure in the study area. The results obtained are useful for preparation of ecology-based pest management tactics and has a scope as IPM tool in the management of fruit borer in Udaipur region.

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