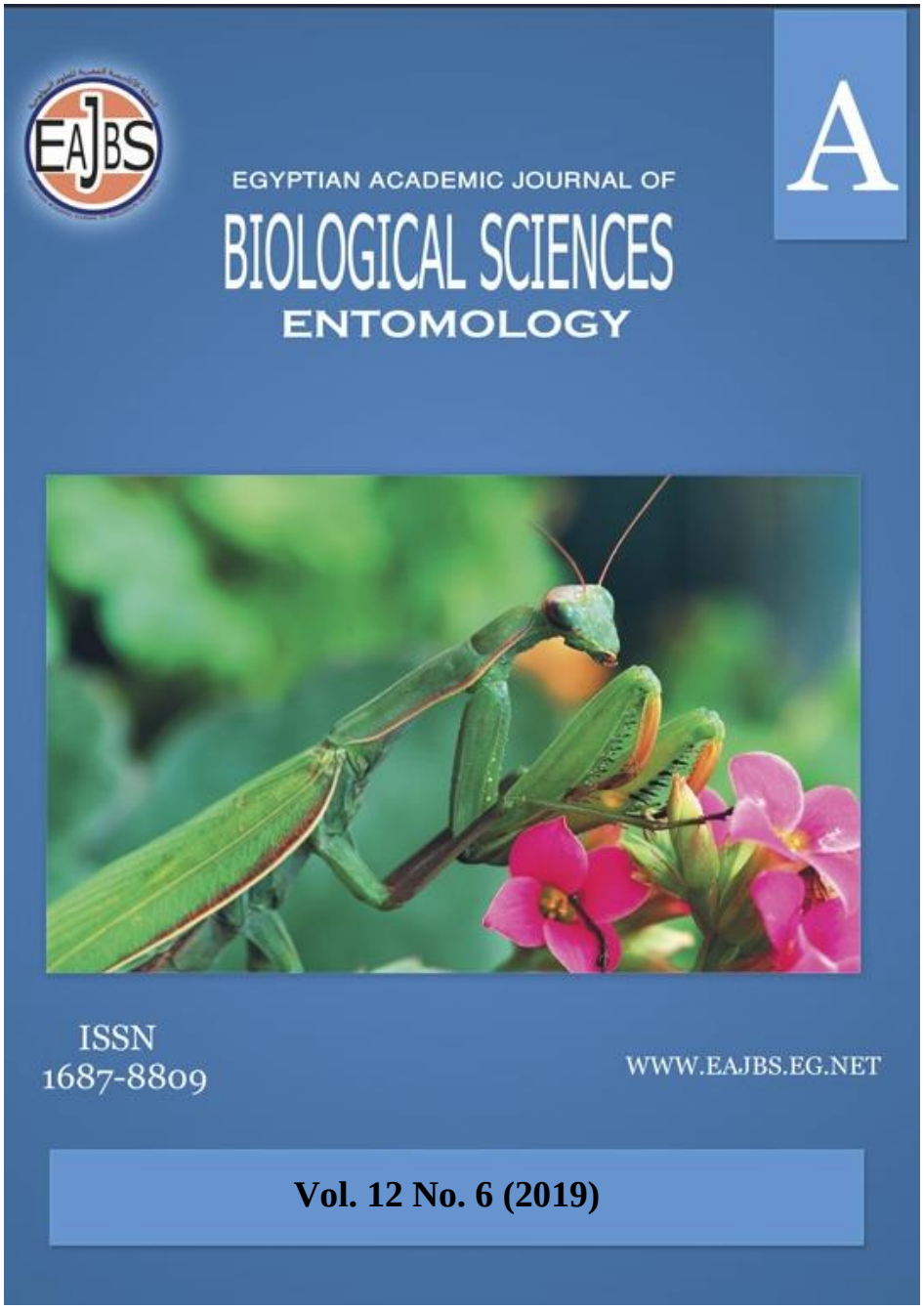

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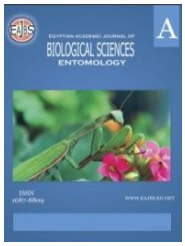

Effectiveness of Different Traps for Monitoring Sucking and Chewing Insect Pests of Crops

Ghulam Murtaza[1], Muhammad Ramzan[2*] Muhammad Usman Ghani[4], Noshaba Munawar[3], Mariam Majeed[3], Azhara Perveen[3], and Kashif Umar[1]

1-Department of Entomology, University of Agriculture Faisalabad, Punjab Pakistan
2-Institute of Plant Protection, MNS-University of Agriculture Multan, Punjab Pakistan
3-Department of Zoology Wildlife and Fisheries, University of Agriculture, Faisalabad
4-College of Agriculture, Department of Agronomy, Bahauddin Zakariya University, Multan, Pakistan
Email: ramzan.mnsua@gmail.com

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ABSTRACT

Various type of sticky traps is frequently used for monitoring the sucking pests like jassid, aphid, whitefly, and thrips. Light traps and pheromones traps are species specific and commonly used for capturing the moths such as *Spodoptera litura, Helicoverpa armigera* and *Leucinodes orbonalis.* The sucking and chewing are very destructive pests of various crops such as cotton, cabbage, brinjal, okra, tomato and onion all over the world, Insect pests are controlled by various methods but insecticides are commonly used method to control these pests. A filed experiment was conducted to determine the attraction of insect pests to different sticky traps like red, blue, yellow, orange, pale yellow-green and white while light and pheromone traps also installed to capture the *Spodoptera litura, Helicoverpa armigera* and *Leucinodes orbonalis* moths during 2019. The study showed that that yellow sticky traps were the most effective for monitoring and managing thrips and whiteflies in cotton crops. In brinjal crop, the highest adult population of thrips, whitefly, jassid, and aphid was 139, 13, 29 and 13 per card, respectively were recorded on green traps. Light traps and pheromone traps were proved effective control against chewing insect pests especially *Spodoptera litura* followed by *Helicoverpa armigera* and *Leucinodes orbonalis.* The current study concluded that eco-friendly and natural approaches such as use of traps are helpful in pest management on agricultural crops.

INTRODUCTION

The economy of Pakistan depends on agricultural crops such as cotton, maize, cabbage, cauliflower, sorghum, and brinjal. Agricultural products are the main source of food to humans (Deshpande *et al*., 1991 and Lizumi *et al*., 2014) and income sources for peoples. The quality and quantity (Oerke, 2006) of crops is reducing day by day due to various reasons such as insect pests (Glen, 2000) and environmental factors. The various insect pests such as chewing (*Spodoptera litura, Helicoverpa armigera* and *Leucinodes orbonalis*) and sucking (*Thrips tabaci, Bemais tabaci* and *Amrasca biguttula*) insect pests attack the crops.

The various management approaches such as cultural, botanical, biological and chemicals have been adopted by peoples to control insect pests. Among all these methods, chemical control is an excessively used method to control the pests. The excessive use of insecticides is harmful to beneficial fauna cause environmental (Pimentel *et al*., 1992) pollution and insect resistance (Reddy, 2011)

An eco-friendly pest management technique is necessary to manage insect pests (Antignus, 2000 and Ben-Yakir *et al*., 2013) resulting high crop production (Yadav *et al.*, 2013) and reducing the use of insecticides (Ramzan *et al.*, 2019). Different types of traps with different colours and shapes (Vernon and Gillespie, 1990; Mainali and Lim, 2009; Lim & Mainali, 2010) have used by various researchers to attract insect pests (Henneman and Papaj, 1999).The population dynamic of insect pests can be monitored through the use of different traps (Epsky *et al.*, 2008). Not only the pest population is reduced but also crop production increase as compared to chemical control (Ramzan *et al.*, 2019)

By keeping the same findings in mind, the present study is conducted in district Multan at a farmer field. During the whole study, the data and pest infestation level based on population dynamics of pests from different crops (cotton) and vegetables (tomato, onion, cabbage, brinjal) is recorded and monitored. The monitoring of pests is done through different traps such as pheromones, light traps, and many others.

MATERIALS AND METHODS

Study Area:

An experimental study was conducted in Faisalabad Punjab, Pakistan during 2019 to check the field population of pests on various crops. The area lies at 31.4504° N latitude, 73.1350° E longitude.

Study Design and Crops:

Sticky cards of different colour with 7.5 by 10.9 cm were purchased from market while white cards made at laboratory. White and yellow sticky traps were placed at equal distance from each other in an acre of agricultural fields like cotton, onion, sorghum, tomato, cabbage and cauliflower to trap the insect pests (sucking and soft body). Five sticky traps were placed per acre, one at center while others four placed at corners of that crop. One pheromone trap and one light trap was also installed per acre to capture the moths such as *Helicoverpa armigera, Leucinodes orbonalis,* and *Spodoptera litura*. The traps were placed in evening time to observed the pest population.

Data Recording:

During the whole study period, data were recorded on weekly basis early in the morning (Sanghi *et al.,* 2014) from agricultural crops such as cotton, onion, sorghum, cabbage, tomato, okra and brinjal (Qayyoum *et al.,* 2014). Pests populations; jassid, thrips, whitefly, and aphid were recorded by counting the number of their adults and nymphs on each sticky trap while adult population was counted that captured in light traps.

Statistical Analysis:

Collected data were statistically analyzed by using SPSS Statistics 26.

RESULTS AND DISCUSSION

The various methods have been adopted to control pests such as cultural, botanical, biological and chemical. Among all these control practices/methods chemical control is widely used for pest control. The excessive use of insecticides to control pest population can cause resistance against insect pests and environmental problems. The various insect pests such as sucking as well as chewing attack on crops and caused huge yield losses (Kataria and

Kumar, 2012). By keeping in mind, there is need to adopt alternative control measures that prove to be helpful in pest management.

The current study was conducted to check the sucking (Jassid, aphid, whitefly, and thrips) and chewing (*Spodoptera litura, Leucinodes orbonalis* and *Helicoverpa armigera*) pest population in cotton, okra, brinjal, tomato and cabbage. The yellow, pale yellow, green, red, white, orange and blue sticky traps were used for trapping the sucking insect pests like jassid (*Biguttula biguttula*), aphid (*Aphis gossypii*), whitefly (*Bemicia tabaci*) and thrips (*Thrip tabaci*) while light traps and pheromones traps for chewing pests like *Leucinodes orbonalis, Helicoverpa armigera,* and *Spodoptera litura.* All sticky traps were found effective for controlling the sucking pests while pheromone and light trap for chewing insect pests.

During the study, it was observed that yellow sticky traps were the most attractant followed by blue and green of whitefly in the cotton filed. The maximum population of whitefly (306**)** observed on yellow sticky traps while lowest at red sticky trap (12). Our findings are in line with the findings of earlier studies (Gupta *et al.,* 2017; Idris *et al.,* 2012). In cotton field, yellow sticky traps were found most attractant of thrips followed by green, pale yellow and white traps. Gharekhani *et al* (2014) suggestions are in line with the current study.

Prema *et al* (2018) have reported similar findings. In the present study, the orange and blue traps were found less attractant of thrips. Jassid population was found highest on green sticky traps while minimum on red traps (Table 1). The maximum population of *Spodoptera litura* was recorded in cabbage (181 adults) light traps followed by cotton (159 adults), okra (139 adults), brinjal (132 adults) and tomato (103 adults). The present study showed that maximum infestation of *Spodoptera litura* was recorded on cabbage followed by cotton. The lowest infestation of *Spodoptera litura* was observed in onion field. Our findings were similar to the findings of other researchers (Gupta *et al.,* 2017).

In tomato crop, aphid population was found the maximum on blue (145) and yellow traps (123) as compared to other traps. Green traps (179) were more attractive to thrips in onion crops. The pale yellow traps were least attractive of onion thrips and jassid, no aphid population was recorded in these traps. Light traps and pheromone traps were proved effective control against chewing insect pests especially *Spodoptera litura* followed by *Helicoverpa armigera* and *Leucinodes orbonalis.* In brinjal crop, the highest adult population of thrips, whitefly, jassid, and aphid was 139, 13, 29 and 13 per card, respectively were recorded on green traps (Table 2). Green was the first while pale yellow sticky traps last attraction for thrips in all crops. The red sticky traps were observed to be a poor attractant of thrips. The highest population from red traps was 45 per card observed from the eight collections

At the initial stage of crops, pest population was less recorded while highest after one month of crop emergence. Our results are in line with Prema *et al* (2018) who have reported that pest populations low at initial stage of crops. Overall, yellow and blue sticky traps were observed to be more attractant of sucking insect pests. from eight collections.

Maximum population of *Spodoptera litura* was captured in a light trap installed in cabbage (181 adults) field followed by cotton (159 adults), okra (139 adults), brinjal (132 adults), tomato (103 adults) and onion (11 adults) (Fig. 1). The sex ratio of *Spodoptera litura*, *Helicoverpa armigera* and *Leucinodes orbonalis* captured by traps on different hosts are given in Figure 2. *Leucinodes orbonalis* and *Helicoverpa armigera* population were found highest in tomato and okra crops, respectively. Pheromone traps were most effective against *Spodoptera litura* and *Helicoverpa armigera* in okra and cotton fields (Table 1) while least against *Leucinodes orbonalis.*

Table1. The population of insect pest's infestation on cotton, maize and tomato crop

Hosts Name	Traps type	Insects						
		Thrips	Whitefly	Jassid	Aphid	American bollworm	Armyworm	Brinjal Shoot Borer
Cotton	Blue Trap	11	15	99	32	0	0	0
	Yellow Trap	299	306	32	45	0	0	0
	White Trap	88	98	45	45	0	0	0
	Green Trap	201	179	111	32	0	0	0
	Red Trap	45	33	19	67	0	0	0
	Pale Yellow trap	9	187	76	89	0	0	0
	Orange Trap	9	12	56	43	0	0	0
	Pheromone Trap	0	0	0	0	43	15	0
	Light Trap	0	0	0	0	2	159	0
Onion	Blue Trap	4	1	24	3	0	0	0
	Yellow Trap	13	3	5	2	0	0	0
	White Trap	3	0	0	1	0	0	0
	Green Trap	179	0	0	1	0	0	0
	Red Trap	1	1	0	1	0	0	0
	Pale Yellow trap	1	2	1	0	0	0	0
	Orange Trap	9	0	0	1	0	0	0
	Pheromone Trap	0	0	0	0	2	13	0
	Light Trap	0	0	0	0	0	11	0
Tomato	Blue Trap	215	99	301	145	0	0	0
	Yellow Trap	123	299	129	123	0	0	0
	White Trap	10	22	65	43	0	0	0
	Green Trap	167	65	21	29	0	0	0
	Red Trap	4	40	8	26	0	0	0
	Pale Yellow trap	3	179	132	34	0	0	0
	Orange Trap	43	51	39	21	0	0	0
	Pheromone Trap	0	0	0	0	17	24	15
	Light Trap	0	0	0	0	11	103	18

Table 2. The population of insect pest's infestation on cabbage, okra and brinjal crop

Hosts Name	Traps Type	Insects						
		Thrips	Whitefly	Jassid	Aphid	American bollworm	Army worm	Brinjal Shoot Borer
Cabbage	Blue Trap	6	21	12	50	0	0	0
	Yellow Trap	12	41	33	13	0	0	0
	White Trap	1	30	12	11	0	0	0
	Green Trap	2	10	3	2	0	0	0
	Red Trap	1	03	2	1	0	0	0
	Pale Yellow trap	0	0	1	3	0	0	0
	Orange Trap	0	1	1	4	0	0	0
	Pheromone Trap	0	0	0	0	8	15	10
	Light Trap	0	0	0	0	6	181	8
Okra	Blue Trap	2	41	19	2	0	0	0
	Yellow Trap	10	41	30	11	0	0	0
	White Trap	2	27	9	0	0	0	0
	Green Trap	2	8	3	2	0	0	0
	Red Trap	1	01	1	0	0	0	0
	Pale Yellow trap	0	0	0	1	0	0	0
	Orange Trap	0	1	1	4	0	0	0
	Pheromone Trap	0	0	0	0	81	111	11
	Light Trap	0	0	0	0	19	139	5
Brinjal	Blue Trap	14	56	50	23	0	0	0
	Yellow Trap	09	117	13	21	0	0	0
	White Trap	1	32	23	1	0	0	0
	Green Trap	139	13	29	13	0	0	0
	Red Trap	0	30	11	0	0	0	0
	Pale Yellow trap	1	10	3	2	0	0	0
	Orange Trap	2	03	2	1	0	0	0
	Pheromone Trap	0	0	1	3	23	17	31
	Light Trap	0	1	1	4	5	132	3

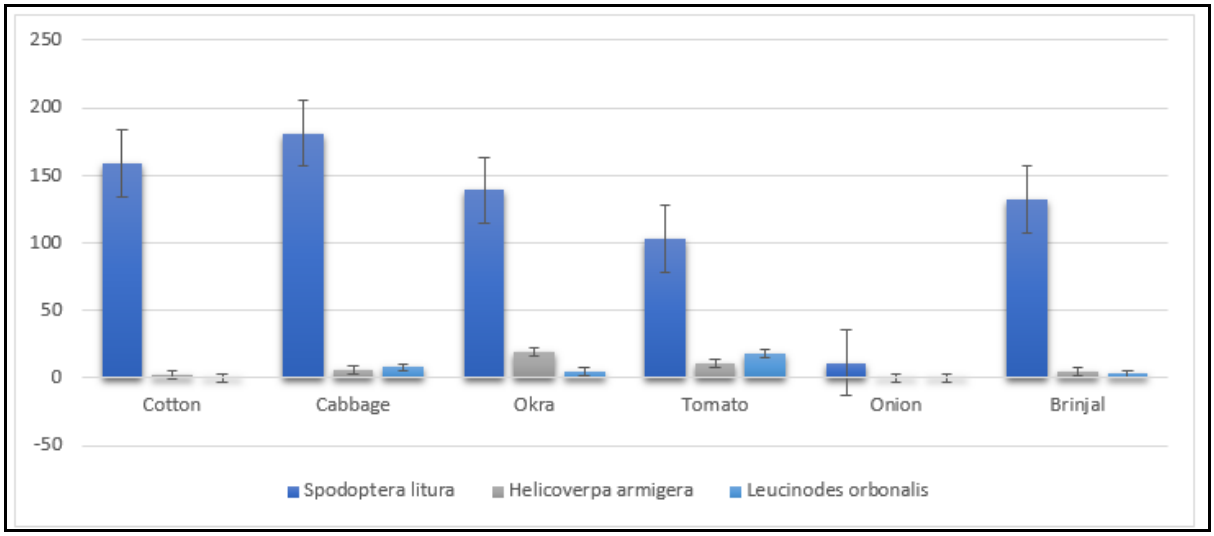

Fig. 1. Total number of moths captured in light traps

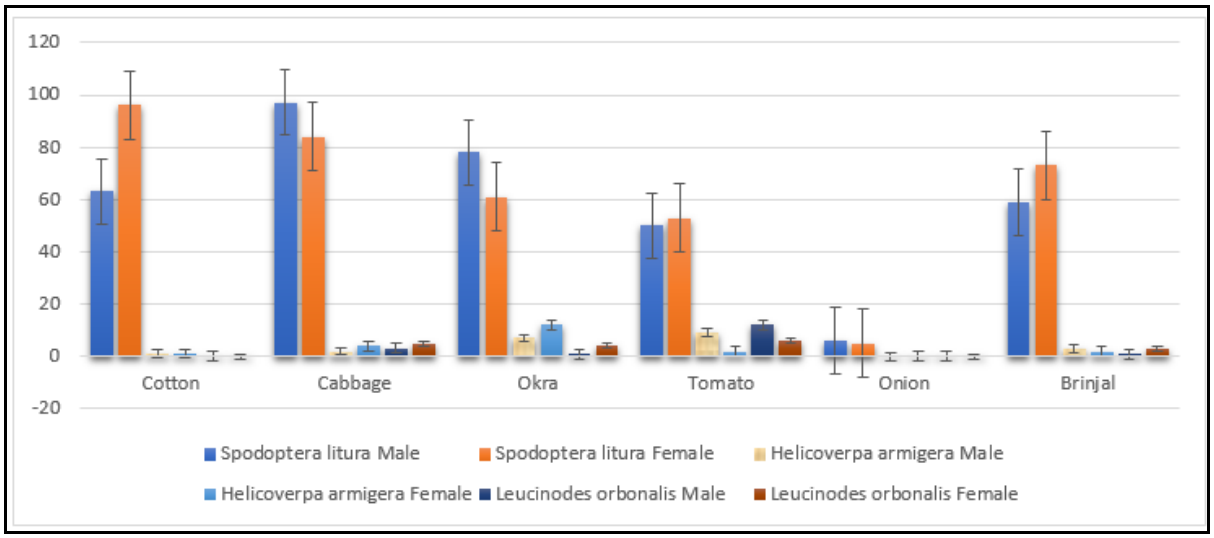

Fig. 2. Sex ratio of *Spodoptera litura*, *Helicoverpa armigera*, and *Leucinodes orbonalis* captured by traps on different hosts

Conclusion

The current study concluded that the eco-friendly and natural approaches are helpful in pest management on agricultural crops. These approaches enable us to carry out sustainable cropping and avoid use of harmful insecticides. The use of species-specific light traps and pheromones are also adding great success for controlling the current insect pests.

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