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Research Article

Influence of Light-trap Catches on Sex Ratio of Insects and Infestation in the Field of Cucurbitaceae

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Abstract: Insects are the curse for any type of crop and stored grains. Many techniques have been used so far to combat them. Pesticides are a major part of these techniques, but they also have negative aspects. In many European countries, the alternative techniques are, in practice, on low scale which is eco-friendly. Light-trap is one of them, which is used to study the effects on cucurbit insect pests in the present study.

Keywords: *Bactrocera strumeta, Luffa aegyptiaca, Pieris brassicae, Dacus cucurbitae, Citrullus vulgaris, Raphidopalpa foveicollis, Luffa cylindrical,* Jermy-type light-trap.

1. Introduction

India is the largest producer of good vegetables after China and USA. The maximum economy of a developing country like India is depended upon the various crops. In tropical countries like India productivity of cucurbits play a very important role as nutrients. This is a fairly large family, well represented in India by plants which are mostly climbing, annual, which grow rapidly and climb by the aid of tendrils. The fruits of cucurbits are generally fleshy, of the type exhibited in pumpkin or the cucumber, which sometimes called pepo with exalbuminous seeds.

Insects have existed on this planet (earth) for over two hundred million years ago, while men, on the scene only half a million years ago.

It is obvious; therefore, that man must face the problem of insect pest quite early in the history of his existence. The insect pests are much harmful to the crops like wheat, pulses and vegetables than rodents. Not only food plant damage by pest, but also ornamental plants as well as medicinal plants damaged by various insect pests.

Continuous damaging of any annual, biannual as well as perennial species of plants if continuously affected by saliva of insect pest may also lose its specific genetic components. Rigveda in its hymns mentioned several insect pests. The Bible, reported at last eleven pests, continuous use of pesticides is responsible for loss of specific plant's productivity as well as various metabolic activities of herbivores and carnivores disturb if continuously any pesticide intake in their body and may cause serious problem like a tumor, cancer, hepatitis problems.

Pesticides are also responsible for the environmental hazardous problem, some insect pest like Lepidoptera, Coleoptera as well as Diptera attract towards moonlight as well as electrical light being might, so it is one of the most successful tactics for protection of different important plants being cropped become by this practice, we can save the environment as well as money and health of producers as well as consumers.

By light trapping, we can also identify various migratory insect pests, which will light various hidden reserves problems.

It is clear that the use of synthetic pesticides always leaves their harmful effect. So, it is most important to apply some mechanical or nonchemical process for protection of food crops against pests.

With the help of light trapping of insect pest, we can also relate environmental aspects with population of different insect pest and their light span related to the environment.

The government of India has recently declared a new policy to permit the import of seeds for crops, including hybrid under a general license, in order to recur for the farmers, high quality pest resistance seeds

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available everywhere in the world to maximize yield, increase productivity and farmer's income, but effort cannot be complete till the apply of physical trapping process of insect from agricultural field.

The use of light traps as an entomological survey device has been in vague for a longer time than the other sampling devices like sweetness, sticky traps, pheromone trap, etc. light traps are especially suited to nocturnal flying insects over a large area. The pheromone of insect attraction to artificial light was recorded by man as early as 525-456 B.C. (Heinton, 1974). However, progress was slow due to use of an oil lamp, which was less efficient. With the introduction of electric lamps, research in this direction developed faster and the invention of mercury lamps led to a new way of investigation. Consequently, the old trapping method replaced by new methods with mercury vapour lamps, as light source (Robinson and Robinson, 1950), resulting in a higher attraction of insect pest. Since then the use of light traps has gained much importance and being utilized for pest survey. Glick and Hollingsworth (1955) used light traps successfully for monitoring cotton bollworms. However, insect control with light traps has also been successfully achieved on Tobacco, Tomato and Hornworms in United State, Stanley and Dominick (1958).

Bhatnagar *et al*., (1977) in India used light traps to know the pest complexities and their wide seasonal fluctuations on legumes, for developing pest forecasting and forewarning systems. In recent times, the value of light traps is "Integrated Pest Management Program" is being stressed and such an integrated approach is highly essential for the management of pest.

Out of $10x10^5$ species of insect found all over the world. Only $10x10^3$ insect are pests, so light trapping help in evaluating the effectiveness of any control procedures that will carry out in a given area and to monitor levels of various economically important species.

2. Materials and Methods

During experiments, investigation carried out together abiotic components which influenced the light traps with reference to trends of insect catch during experiments. Light trapping of insect population noted relative catches (RC) that is a collection of different orders with relation to abiotic factors. The relative catches (RC) defined as a quotient of the number of individuals caught during the sampling time (night).

In this work relation between temperature, humidity, as well as the velocity of air, studied with an insect population of different orders, which compose with the nontrapped field productivity.

Studied were conducted is selected, three crop field stations in Etah, which are crop field of the Ganjdundwara village for crops of *Luffa cylindrical* (Ghia), *Luffa aegyptiaca* (Torai) and *Citrullus vulgaris* (Tinda).

2.1 Instruments

Following instruments have been used for light trapping:

- **a.** Jermy-type light-trap
- **b.** The killing jars, filled with ethanol (C_2H_5OH)
- **c.** Humidity meter
- **d.** Thermometer

The insect which caught by light trapping has not gotten in contact with the chloroform for killing because of its strong fat dissolving action.

The trapping used during the first and second crop season respectively as per crop season from October 2010 to March 2011 for *Luffa cylindrical* and *Luffa aegyptiaca*. *Citrullus vulgaris* from March 2010 to August 2011.

2.2 Study period

Studies were conducted to fix the peak period of activity of different group of insects.
The period were-

- **a.** 6.00 PM to 8.00 PM
- **b.** 8.00 PM to 10.00 PM
- **c.** 10.00 PM to 12.00 PM
- **d.** 12.00 PM to 6.00 PM

Data were gathered separately for each crop when there was a peak population of insects.

Again a correlation was worked out between the light-trap catches and the corresponding week average number of insect to know the effect of the light-trap catch of different insect population in the field.

During trapping temperature, humidity and velocity of air, as well as the pH of the soil, also noted to find out the correlation between light trapping and abiotic factors.

The log values of the total catch of each crop field in relation to physical factors have represented by respective histograms. To avoid swamping of result, the catch values for experimental orders are divided separately.

The light-trap used for the purpose in the present observation has done at a height of 1.5 meters with Jermy-type light-trap. It is placed in a corner of the crop field of the selected station. A regular operation of the light-trap was conducted during the night. Entire catch of the night was then shorted out with morning. A daily record of the individual of different orders attracted to light has regularly maintained the temperature recorded by centigrade thermometer, whereas the relative humidity was determined by the standard values of humidity meter.

The experimental finding indicates the colour attracting response in experimental three light sources, i.e. green, yellow and red were used to find out their relative efficiency for insect pest attraction.

The green colour had a peak emission around 554µ, bellow around 575µ and red with 610µ. The measurement of light wavelength has been done with

the help of spectrophotometer by the light dispersion method.

The locations of different colour light sources were interchanged daily. Insect pest studied were *Raphidopalpa foveicollis* and *Bactrocera strumeta* of *Luffa aegyptiaca* field, *Raphidopalpa foveicollis*, *Pieris brassicae* and *Dacus cucurbitae* of *Citrullus vulgaris* field and *Raphidopalpa foveicollis* of *Luffa cylindrical* field. Observations were taken during each first crop season only.

3. Results

3.1 Sex-Ratio and reproductive status of light trapped insects in different crop fields

The sex ratio and the reproductive ratio of the insects in experimented crops have studied for a period of 5 standard weeks when the insect attraction was at its peak. The trapped insect pests of each experimental crop were separated as male and female by observing the differences like and style, cevci and oviposition.

3.1.1 In the field of *Luffa cylindrical*

The sex ratio of *Raphidopalpa foveicollis* as male: female during light trapping in crop field of *Luffa cylindrical*, recorded as 1:2.8 out of the percentage of female on the basis of phenotype was recorded 73.77.

Table 1. Sex ratio and Reproductive status of *Raphidopalpa foveicollis* (Coleoptera) in the field of *Luffa cylindrical*.

Std. Week No.	*Raphidopalpa foveicollis* (Coleoptera)			
	Total Moth	Male	Female	Spent
1	258	81	177	124
2	284	144	140	65
3	348	21	327	162
4	255	74	181	110
5	123	13	110	58
Total	1268	333	935	519
Sex ratio and % of spent or Gravid females	1:2.80	73.73%	40.93%	

3.1.2 In the field of *Luffa aegyptiaca*

a. *Raphidopalpa foveicollis*

The proportion of male and female beetles among the light trap catches varied widely. More female was attracted than males and the ratio between male and female was 1:26 out of the total female trapped 96.30% of the beetles were spent females.

b. *Bactrocera strumeta*

The proportion of male and female *Bactrocera strumeta* of the order Diptera varied slightly and male: female was 1:2.68. Among the females trapped 72.79% was recorded.

Table 2. Sex ratio and Reproductive status of *Raphidopalpa foveicollis* (Coleoptera) and *Bactrocera strumeta* (Diptera) in the field of *Luffa aegyptiaca*.

Std. Week No.	*Raphidopalpa foveicollis* (Coleoptera)				*Bactrocera strumeta* (Diptera)			
	Total Moth	Male	Female	Spent	Total Moth	Male	Female	Gravid
1	348	21	327	162	360	81	279	147
2	521	11	510	275	258	81	177	124
3	532	18	514	264	274	79	195	137
4	418	19	399	211	255	74	181	110
5	402	13	389	206	110	27	83	59
Total	2221	82	2139	1118	1257	342	915	577
Sex ratio and % of spent or Gravid females	1:26	96.30%	50.34%		1:2.68	72.79%	45.90%	

3.1.3 In the field of *Citrullus vulgaris*

a. *Raphidopalpa foveicollis*

Male and female of the trapped insect were observed to be more or less equal and the ratio was 1:24.14. Among the female trapped 96.17% were spent insects.

b. *Pieris brassicae*

Male and female of trapped insects was observed to be more or less equal and the ratio was 1:1.09. Among them, female trapped 72.79% was recorded.

c. *Dacus cucurbitae*

Male: female trapped insect of *Dacus cucurbitae* was observed 1:2.69. Among them, female trapped 72.88% was recorded.

Table 3. Sex ratio and Reproductive status of *Raphidopalpa foveicollis* (Coleoptera), *Pieris brassicae* and *Dacus cucurbitae* in the field of *Citrus vulgaris*.

Std. Week No.	*Raphidopalpa foveicollis* (Coleoptera)				*Pieris brassicae*				*Dacus cucurbitae*			
	Total Moth	Male	Female	Spent	Total Moth	Male	Female	Gravid	Total Moth	Male	Female	Spent
1	327	26	301	162	360	81	279	147	359	80	279	146
2	421	12	409	275	258	81	177	124	257	81	176	123
3	618	18	600	264	274	79	195	137	273	78	195	138
4	402	13	389	211	255	74	181	110	255	73	182	110
5	532	19	513	206	110	27	83	59	110	28	82	59
Total	2300	88	2212	1118	1257	342	915	577	1254	340	914	576
Sex ratio and % of spent or Gravid females	1:25.14	96.17%	48.60%		1:1.09	72.79%	45.90%		1:2.69	72.88%	45.93%	

3.2 Relation between light trap catches infestation

a. In the field of *Luffa cylindrical*

In *Luffa cylindrical* correlation was worked out between the population caught in trap during experimented time and the percentage infestation of 20th standard week after the catch. The correlation coefficient of +0.99 was non-significant.

Table 4. Relation between light trap catches and infestation by *Raphidopalpa foveicollis* (Coleoptera) in the field of *Luffa cylindrical.*

Standard Week No.	Light trap catches	% of Damage
12	2	.0544
13	4	.108
14	7	.190
15	6	.163
16	57	1.55
17	59	1.60
18	218	5.92
19	111	3.01
20	584	15.88
21	136	3.69
22	521	14.17
23	378	10.28
24	376	10.22
25	156	4.24
26	319	8.67
27	367	9.98
28	178	4.84
29	632	17.19
30	724	19.69
31	26	.70

R = +0.99

b. In the field of *Luffa aegyptiaca*

Correlation between the light trap catches of *Raphidopalpa foveicollis* and the percentage infestation (3rd standard week after the catch) over different periods was worked out. The correlation coefficient was 0.53 and it was non-significant.

Table 5. Relation between light trap catches and infestation by *Raphidopalpa foveicollis* (Coleoptera) in the field of *Luffa aegyptiaca.*

Standard Week No.	Light trap catches (Weekly Total)	% Infestation of 3 weeks after the catch
52	257	21.28
1	169	27.74
2	181	27.92
3	348	27.84
4	521	27.46
5	532	8.50
6	418	9.48
7	462	11.68

R = +0.53

Percentage infestation of *Luffa aegyptiaca* on 3rd standard weeks after the catch in the light trap during the 8th standard week was taken for correlation.

In *Bactrocera strumeta* a correlation was worked out between the population caught in traps during the 7th standard week and the percentage infestation of three standard weeks after the catch. The correlation coefficient +0.74 was non-significant.

Table 6. Relation between light trap catches and infestation by *Bactrocera strumeta* (Diptera) in the field of *Luffa aegyptiaca.*

Standard Week No.	Light trap catches (Weekly Total)	Percentage of silver shoot damage by gall midge (3 weeks after the catch)
33	4	2.72
34	12	5.43
35	24	4.67
36	48	2.11
37	99	1.99
38	149	1.11
39	120	2.11

R = +0.74

c. In the field of *Citrullus vulgaris*

The light traps catch of *Raphidopalpa foveicollis* obtained during the 12th standard week and field incidences during the corresponding period were correlated. A significant positive correlation coefficient of +0.95 was observed between the trap catches and field pest population level.

Table 7. Relation between light trap catches and infestation by *Raphidopalpa foveicollis* (Coleoptera) incidence in the field of *Citrullus vulgaris.*

Standard Week No.	Light trap catches (Weekly Average)	*Raphidopalpa foveicollis* No./Hill (Mean of 2 Observations)
33	0.43	0.00
34	4.00	0.10
35	5.00	0.20
36	3.43	0.10
37	7.86	0.30
38	85.00	1.20
39	105.29	1.60
40	68.00	1.10
41	668.86	4.30
42	1654.29	10.50
43	1244.14	7.52
44	640.57	8.20

R = +0.95

The light trap catches of *Pieris brassicae* obtained during the 12th standard week and field incidence during the period eggs shown.

A significant positive correlation coefficient of +0.3329 between the traps catches and field population level.

The light trap catches of *Dacus cucurbitae* obtained during the 12th standard week and field incidence during the corresponding period were correlated.

A significant positive correlation coefficient of +0.9463 was observed between the trap catches and field pest population level.

Table 8. Relation between light trap catches and infestation by *Pieris brassicae* (Lepidoptera) incidence in the field of *Citrullus vulgaris.*

Standard Week No.	Light trap catches (Weekly Average)	*Pieris brassicae* (Mean of 2 Observations)
33	2.54	0.91
34	2.37	1.39
35	2.43	1.87
36	2.26	2.33
37	3.35	2.59
38	2.45	2.57
39	3.08	2.71
40	2.88	2.80
41	2.55	2.86
42	2.01	2.59
43	2.96	2.70
44	2.77	2.63

R = +0.3329

Table 9. Relation between light trap catches and infestation by *Dacus cucurbitae* (Diptera) incidence in the field of *Citrullus vulgaris.*

Standard Week No.	Light trap catches (Weekly Average)	*Athalia Lugens Proxima* (Mean of 2 Observations)
33	1.96	1.67
34	1.94	1.77
35	2.10	1.87
36	1.93	1.93
37	3.49	2.28
38	3.16	2.52
39	3.56	2.85
40	3.54	3.14
41	3.71	3.49
42	3.97	3.59
43	4.44	3.84
44	4.49	4.03

R = +0.9463

4. Discussion

4.1 Sex ratio and reproductive status of insect pest attracted to light traps

a. In the field of *Luffa cylindrical*

Raphidopalpa foveicollis female were caught more in traps and the proportion of spent amount the total was 73.73%, this indicates the most of the insect pests effected to the trap on the after egg laying.

b. In the field of *Luffa aegyptiaca*

In the field of *Luffa aegyptiaca* to selected insect pest have been collected by light trap and counted separately, according to gender. *Raphidopalpa foveicollis* females were caught more in traps and the proportions spent among the total females were 50.34%. This indicated that most of this pest was attracted to the traps only after egg laying, which is supported by findings of Pathak (1968) and Ishikura (1945).

With regard to *Bactrocera strumeta*, the ratio of males to females caught was not more differentiated as in *Luffa aegyptiaca*. The proportion of gravid among the total female were 45.90%. This indicates the more than help of *Bactrocera strumeta* pest were fertile before ovipositor.

c. In the field of *Citrullus vulgaris*

Raphidopalpa foveicollis females were caught more in traps and the proportion of spent among the total, females was 48.60%. This indicated that most of the insect pest was attracted to the traps only after egg laying with regard to *Dacus cucurbitae* the ratio of male were lower than females and the proportion of spent among the total female was 45.93%.

In the case of *Pieris brassicae* females are also more in numbers than male during light trapping and the population is 45.90%. The field incidence of these insect pests did not differ significantly between light trapped areas and light shadow areas. There was no reduction in the incidence due to light trapping. Though the correlation between the trap catches and the insect pest was positive, it was not significant.

The finding of Lam and Stewart (1969) with reference to insect pest was in a similar trend as stated above. Hence, in general, as the wavelength increased attraction of *Bactrocera strumeta* decreased.

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