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Seasonal activity of insect fauna collected through light trap in polyhouse

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Abstract
Seasonal changes in the activity of insect fauna monitored by light trap catches (weekly total) operated by Light trap model SMV 4 using UV (8+8 watt) light source 12" Tube length throughout the active season during the period September to March 2nd week 2020. This study examined the seasonal activity of 14 species out of which 8 are Beneficial and 6 are Harmful. The species *viz. Chlaenius circumdatus*, *Ophionea indica*, *Dytiscus marginalis*, *Brachinus longipalpis*, *Chlaenius nigricans*, *Chlaenius medioguttatis*, *Coccinella septumpunctata*, *Sirthenea carinata*, *Forficula auricularia*, *Riptortus strenuus*, *Gryllus bimaculatus*, *Cofana spectra*, *Flata sps.*, *Spodoptera litura* were observed in trap catches operated inside polyhouse (crop: tomato) regularly. It was found that Coleoptera is the most diverse insect order in polyhouse ecosystem followed by Orthoptera. Peaks were observed in general, showing highest and lowest activity both.

Keywords: Light trap**,** ultraviolet, insect fauna, polyhouse, beneficial insect, harmful insect

Introduction
Insect light trap is one of the very effective tools of insect pest management in organic agriculture as it mass-traps both the sexes of insect pests and also substantially reduces the carryover of pest population. By monitoring with light traps, they will know better what types of insects are there in the field and whether they are in controllable level or not. Many insects are positively phototrophic in nature and use of light traps for insect catches produces valuable faunistic data. This data can be seen as a parameter of health of biodiversity of the concerned vicinity. The data provided by light trap catches could throw light on period of maximum activity of insects. (Dadmal and Khadakkar, 2014) [1]. Light traps are used for general survey of insect diversity and usually are simple interception devices that attracts and capture insects moving through an area. Use of light trap is one such approach in which pest control is achieved without the use of insecticides (Vaishampayan and Vaishampayan, 2016) [2]. Nocturnal insects are often attracted to light sources that emit large amount of UV radiation, and devices that exploit this behavior, such as light traps for forecasting pest outbreaks, and electric insect killers, have been developed (Shimoda and Honda, 2013) [3]. It is rather used to protect the plants from the adverse climatic conditions such as wind, cold, precipitation, excessive radiation, extreme temperature, insects and diseases. It is also of vital importance to create an ideal micro climate around the plants. This is possible by erecting a polyhouse, where the environmental conditions are so modified that one can grow any plant in any place at any time by providing suitable environmental conditions. The low cost Polyhouse is economical for small and marginal farmers, who cannot afford huge cost of high-tech polyhouse (Yadav *et al.* 2012) [4]. Insect infestation on polyhouse cultivated crops reduces yield as well as quality of the product. This loss can be minimized by using insecticides. Insect infestation on polyhouse cultivated crops reduces yield as well as quality of the product. This loss can be minimized by using insecticides. Band *et al.* 2019 observed the seasonal activity of insets-pests (*viz, Holotrichia consanguinea, Gryllus bimaculatus, Gryllotalpa orientalis, Hyblaea puera, Plusia chalcites, Spodoptera litura and Spilosoma obliqua)* collected in light trap during Kharif season. They observed the changes in populations with major peaks throughout the active season during the period.

Materials and Methods
The experiment was conducted by using a light trap (model SMV 4) installed inside polyhouse at Krishi Vigyan Kendra Jabalpur.

Light trap was operated every night using Ultraviolet (8+8 watt) light source 12" Tube length during the period from 3rd week of September till 2nd week of March, (2019-2020). The experiment was based on catches obtained on daily basis by operating the light trap throughout the season and were converted into standard weekly averages. As per the objectives of the study experiments conducted inside polyhouse ecosystem. Total insect fauna was observed and sorted out on the basis of orders and families of beneficial and harmful species.

Data of daily trap catch was maintained. Insects were collected every morning by hand picking. The insects collected in the collection bag were killed by the exposure of Dichlorvas (Nuvan) 76 EC vapors (as fumigating agent) and placed in a collection unit for instant killing of trapped insects. A record of day to day collection was maintained and weekly average of per day catch was computed following the standard weather weeks.

Results and Discussion

Seasonal activities of insect fauna including both beneficial and harmful species collected through light trap in polyhouse. The data of every day catch of major insect pests collected in trap were converted to weekly total (corrected to seven days) in Table No.2 (Beneficial fauna) and Table No.3 (Harmful species). In all, 14 species of insect- pests were observed in the crop ecosystem, having regular occurrence in light trap catches which have been listed in Table No.1. In accordance with present findings Sharma *et al*., 2004 also reported a record of 62 species through light trap catches during the cropping season of paddy at Jabalpur (2002-03). These species belonging to 8 orders and 33 families. Lepidoptera was the largest order with 27 species, followed by Hemiptera (14 species), Coleoptera (12 species) and Orthoptera (4 species). Odonata, Hymenoptera, Isoptera and Dictyoptera were the other orders of minor significance.

Based on the present findings, several workers *viz*., Bharti *et al*., 2009 [5] and Sharma *et al*., 2004 [6] reported that besides the pests natural enemies are also collected in light trap along with pests. Therefore collection of information and documentation on major species of insect pests and natural enemies collected in light trap in paddy ecosystem is also very important. The present study deals with comparative analysis on activity of major predatory and pest species of paddy based on light trap catches.

Seasonal activities of insect fauna are described below

1. Ground beetle (*Chlaenius circumdatus* Dejean)

It is a general predator of caterpillars and soft bodied insects. The insect was active from IV week of September to February II week. Activity started on September IV week at moderate level. Population reached at its peak on October III week and keeps on declining and finally declined on February II week. No activities were seen from February II week (fig.1) onward up to the end of the season. Population trend in seasonal activity, showed one peak in October I week, while another additional peak was observed in October III week (15 and 24 beetles) respectively.

2. Ground beetle (*Ophionea indica* Thunberg): It is one of the important predator of nymph and adult of brown plant hopper. Both the grubs and adults of the carabid beetle are reported as an important predator. The insect was active from 2nd week of October. Activity started in October II week at peak level (21). Population declined and no activity observed at November IV week and December I week (0 and 0) respectively. Population started declining and again no activity observed then as showed in fig.2.

3. Ground beetle (*Brachinus longipalpis* Wiedemann): General predator. The insect was active from last week of October. Activity started in Oct IV week and remained constant at Nov I week. Population declined (fig.3) from Nov II week to Jan III week then population reached at peak at Jan IV week and Feb I week (4 and 5 beetles) respectively. No activity observed from then onwards.

4. Ground beetle (*Chlaenius nigricans* Riley and Clausen): Predaceous upon *Laphgma pyrausta nubilalis* and *Pinusinsiguos sp.*1821. They have characteristic double-hooked mandibles. The larvae feed exclusively on amphibians, which they lure by making prey-like movements. The adult beetles are generalist predators, but can also feed on amphibians much larger than themselves. The insect was active from first week of October. Activity started in Oct I week and slightly increases at Oct IV week (fig.4). Population declined from Nov II week then no activity was observed from Dec III week onwards.

5. Ground beetle (*Chlaenius medioguttatis* Chaudoir): It is a general predator of lepidopterous larvae. The insect activity started from October III week with a peak of 3. Activity started in Oct I week and slightly increases at Oct IV week. Population started (fig.5) declining from Nov I week onwards and no activity was observed then.

6. Lady bird beetle (*Coccinella septumpunctata* De Bach and Lefroy): The insect activity started from Sept III week activity increased in Sept IV week and showed a peak at Sept IV week (26) and population declined from Sept IV week onwards till Nov I week and then no activity was observed as showed in fig.6.

7. Water beetle (*Dytiscus marginalis* Linnaeus): They are the predaceous diving beetles. Scavenger beetles will feed on decomposing organic material that has been deposited. The scavenged material can come from aquatic vegetation, feces, or other small organisms that have died. The insects activity were started from Sept III week with a peak(40) and then population of insect started declining from September IV

week and gradually declined till December I week and from then onwards no activity was (fig.7) observed in the season.

8. Assassin bug (*Sirthenea carinata* Fabricius)
The Reduviidae are members of the suborder Heteroptera of the order Hemiptera. The family members are almost all predatory. They are general predators. Nymphs and adults of most species are predatory upon other insects. *Sirthenea* is one of the genera included and is exceptional in being subterranean. *Sirthenea carinata* is a generalist predator of mole crickets. Insect was active during the season from October III week to November I week. Activity started in October III week at low level. Initially no activity was seen (fig.8) from September III week to October II week and then population of insect started declining and from November II week onwards no activity was observed in the season.

Seasonal activities of insect–pests are described below

1. Black bug (*Riptortus strenuus* Fabricius): Most hemipterans are phytophagous. These include leafhoppers, plant hoppers, aphids, whiteflies, scale insects, and some other groups. Some are monophagous, being host specific and only found on one plant taxon, others are oligophagous, feeding on a few plant groups, while others again are less discriminating polyphagous and feed on many species of plant. Pest was active during the season (fig.9) from October II week to December II week. Activity started in October II week. Initially no activity was seen from September III week to October I week. Population reached at its peak in October III week with catch of 17. Then the population started declining from November IV week onwards and becomes zero.

2. White Leaf hopper (*Cofana spectra* Distant): The white leafhopper (WLH) Cofana spectra is a pest, which suck sap from the leaves and results drying of leaf tips leading the leaf tip orange and curl. Pest was active during the season from October III week to November I week. Activity started in October III week. Initially no activity was seen (fig.10) from September III week to October II week. Then the population started declining from November II week onwards and becomes zero.

3. Hopper (*Flata sps.* Fabricius): Pest of various crops. Pest was active during the season from October II week to November I week. Activity started in October II week at low level. Initially no activity was seen (fig.10) from September III week to October I week population reached at a peak in October II week (10). Then the population started declining and no activity seen from November II week onwards.

4. Earwig (*Forficula auricularia* Linnaeus): Earwigs have occasionally become a problem in greenhouse crops by moving into the crop canopy and damaging fruit. Pest was active during the season from October I week to November III week. Activity started from October I week at a peak level (16 earwigs). Initially no activity was seen in September III week and September IV week. Then the population started declining (fig.11) from October III week and no activity seen from November IV week onwards.

5. Field cricket (*Gryllus bimaculatus* De Geer): Cricket is an opportunistic scavenger and will feed on a variety of organic material. In greenhouses, it is known to damage young plants. Pest was active during the season from September III week to January II week. Activity started from September III week. Then the population started increasing and showed 2 peaks in September IV week and October I week (31 and 33) respectively. Then there was no activity of pest (fig.12) from November II week to December I week. Again shows a peak of 4 in January II week and from this onwards no activity recorded.

6. Tobacco caterpillar (*Spodoptera litura* Fabricius): *S. litura* and *H. armigera* also cause considerable damage in some polyhouses. *S. litura* and *H. armigera* also cause considerable damage in some polyhouses. It is a polyphagous pest and has been reported to do serious damage as foliage feeder in crops like groundnut, tomatoes, cabbage, cauliflower and many Kharif pluses like moong, urd and soybean. Leaf defoliator and also damages fruits. Pest was active during the season from November I week to March II week. Activity started from November I week. Population showed (fig.13) a highest peak of 7 in December I week and again of 6 in March II week. Initially no activity was seen from September III week to October IV week.

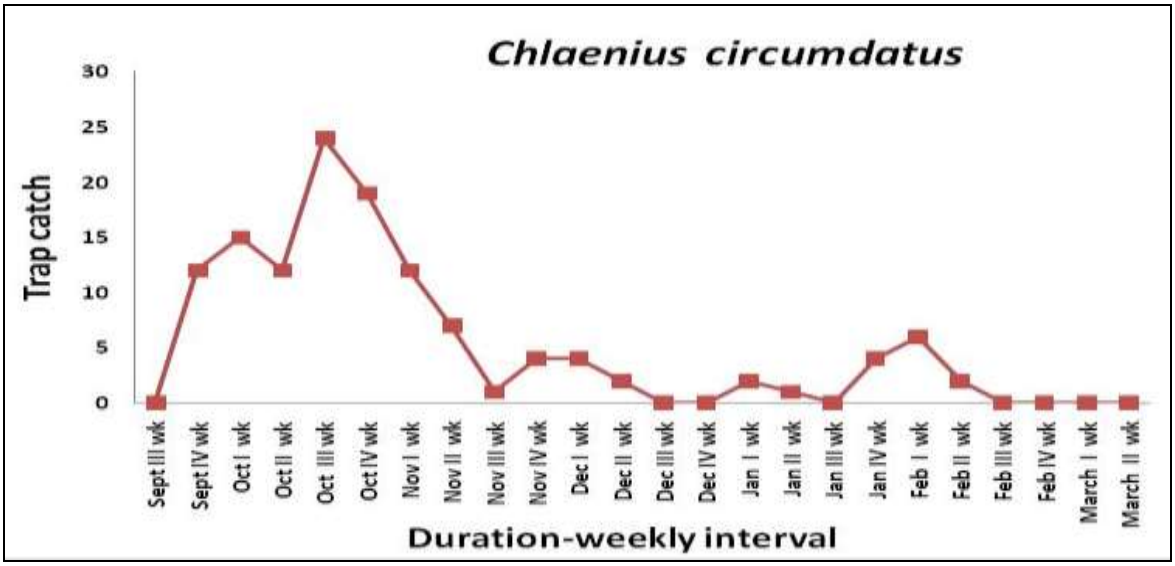

Fig 1: Seasonal activity of Ground beetle (*Chlaenius circumdatus*)

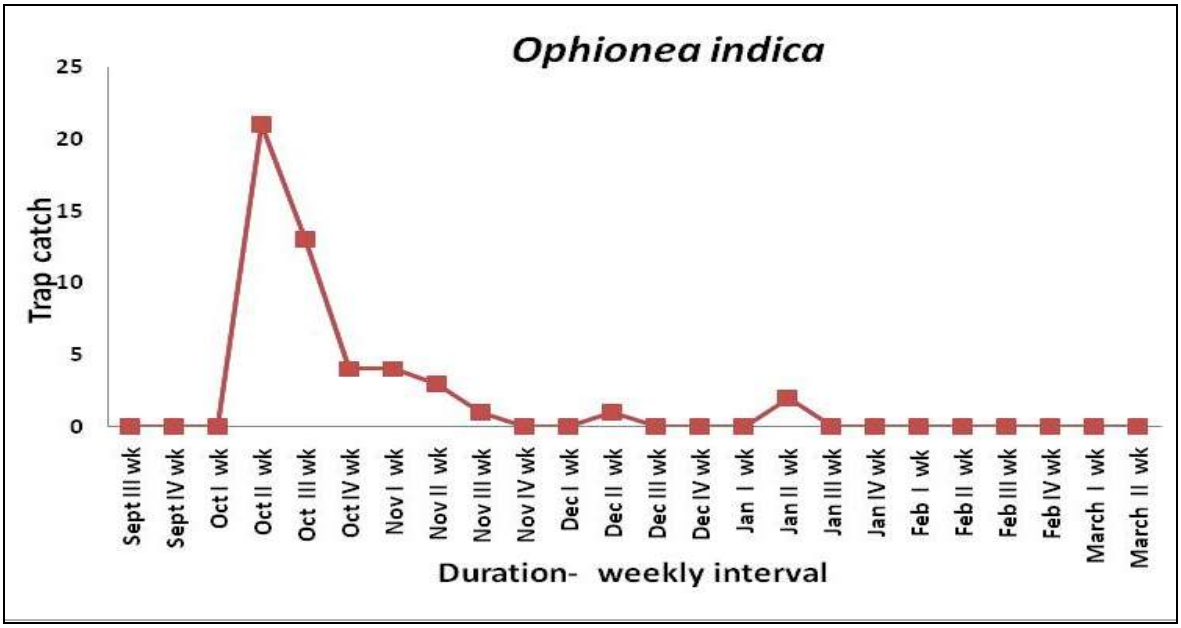

Fig 2: Seasonal activity of Ground beetle (*Ophionea indica*)

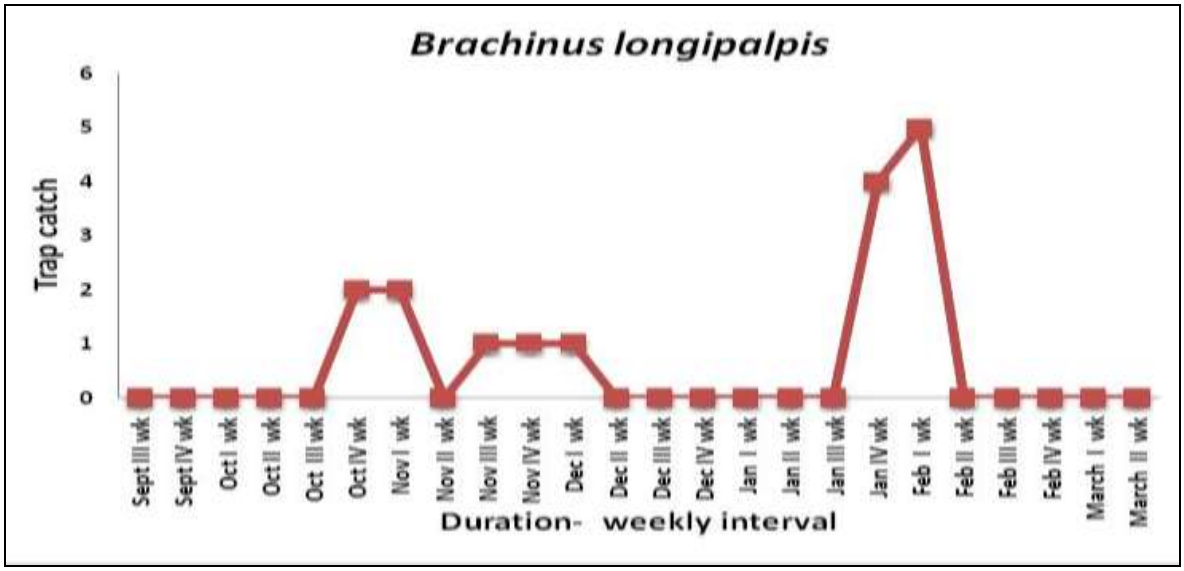

Fig 3: Seasonal activity of Ground beetle (*Brachinus longipalpis)*

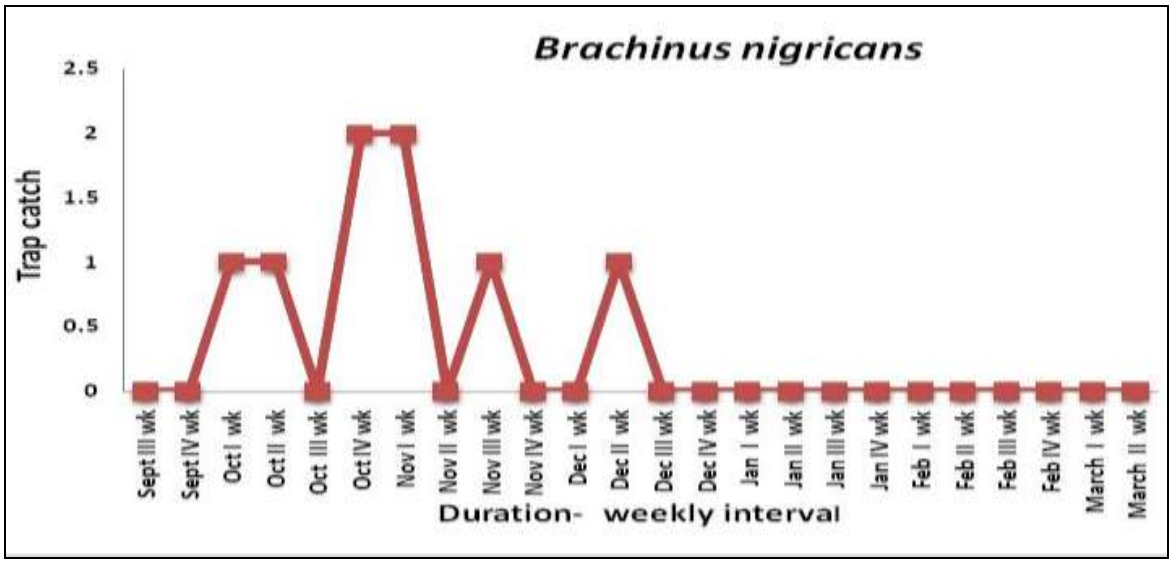

Fig 4: Seasonal activity of Ground beetle (*Brachinus nigricans*)

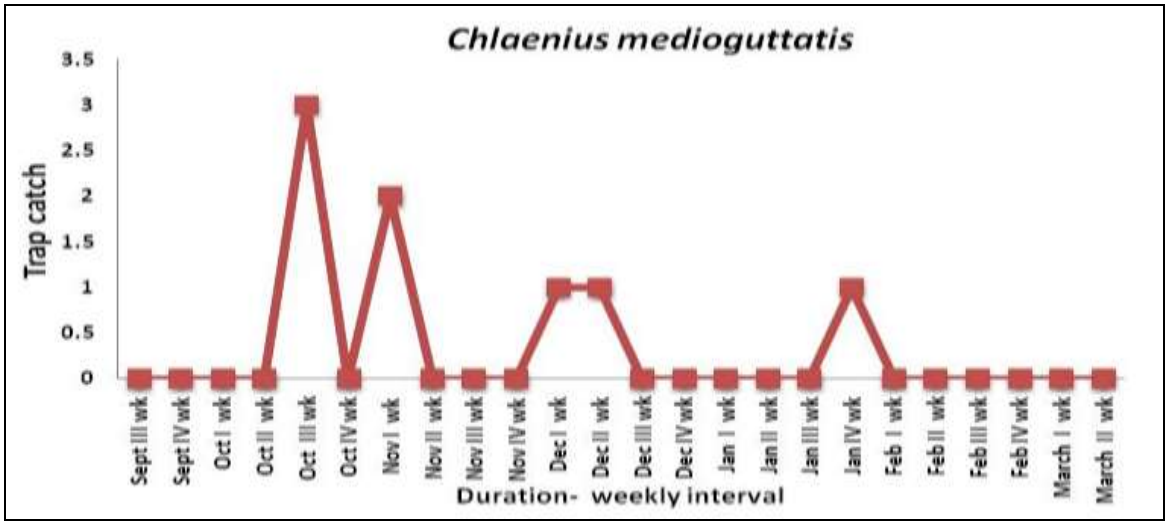

Fig 5: Seasonal activity of Ground beetle (*Chlaenius medioguttatis*)

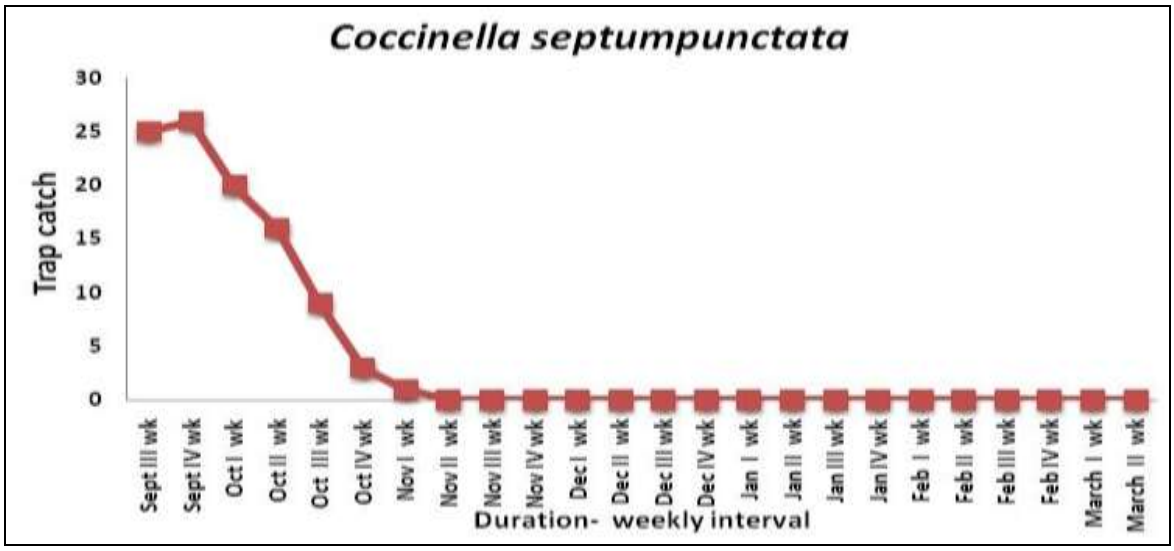

Fig 6: Seasonal activity of Lady Bird beetle (*Coccinella septumpunctata*)

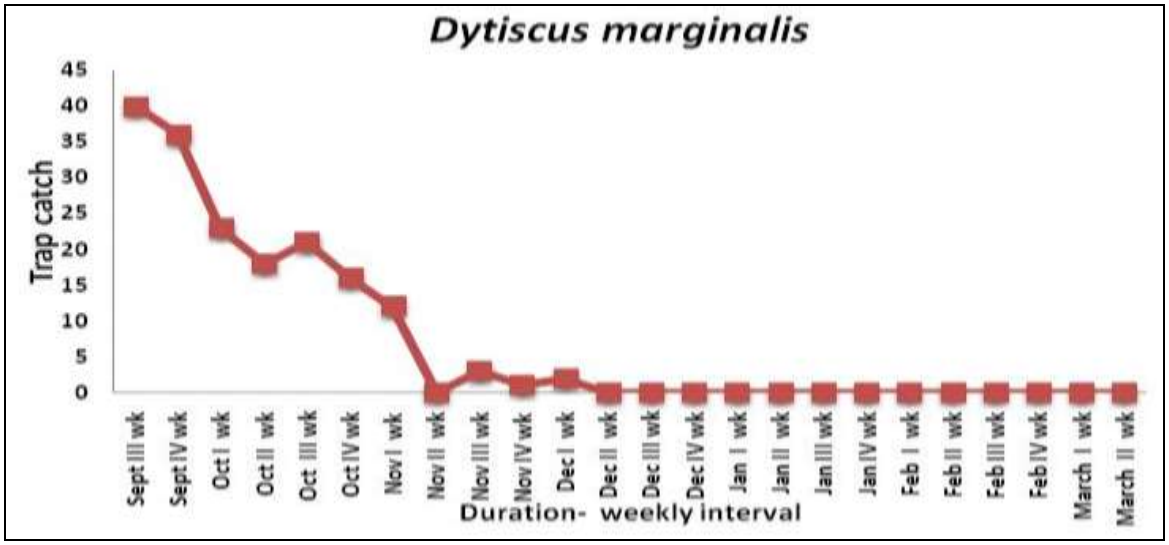

Fig 7: Seasonal activity of Water beetle (*Dytiscus marginalis*)

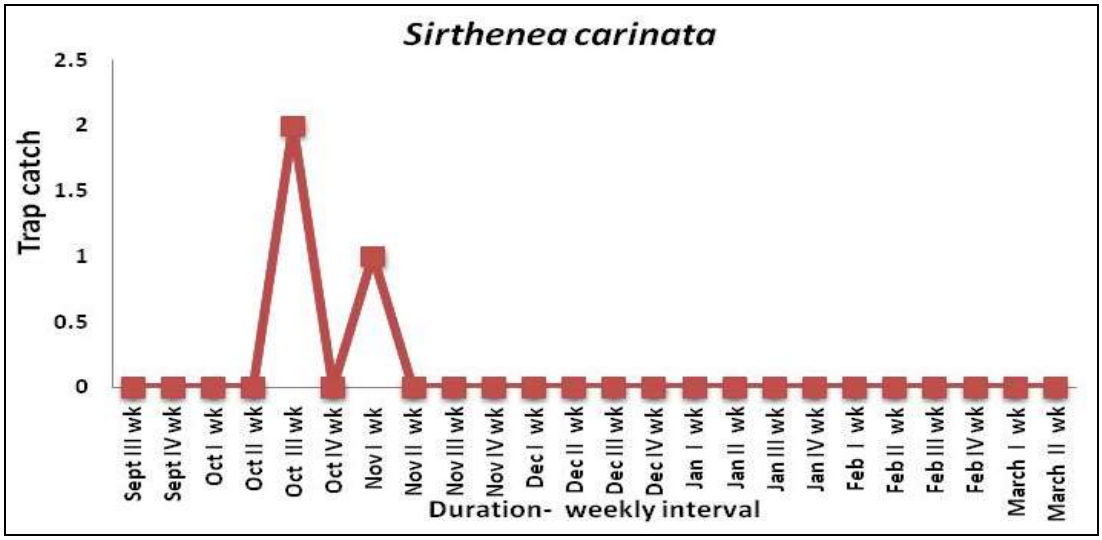

Fig 8: Seasonal activity of Assassin bug (*Sirthenea carinata*)

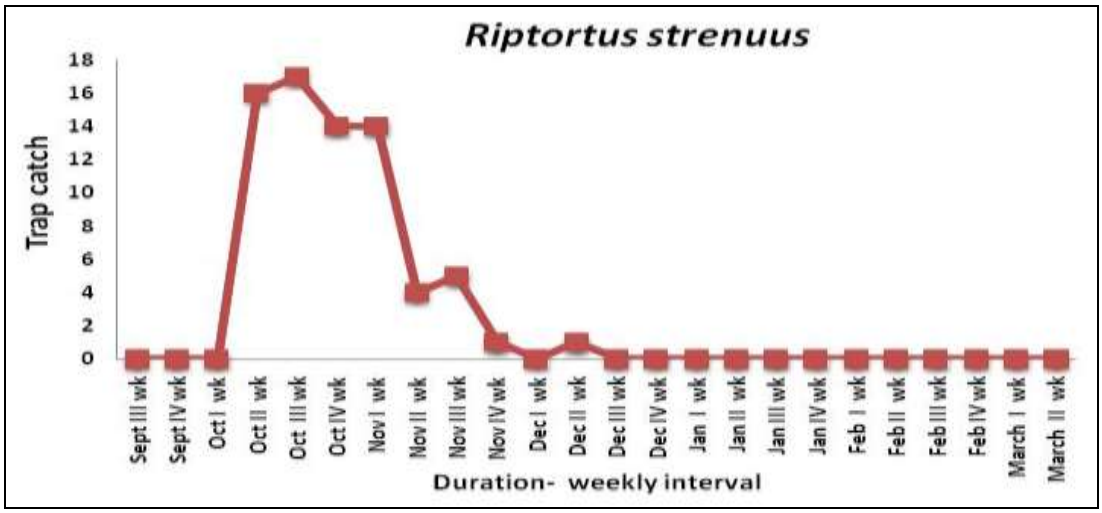

Fig 9: Seasonal activity of Black bug (*Riptortus strenuus*)

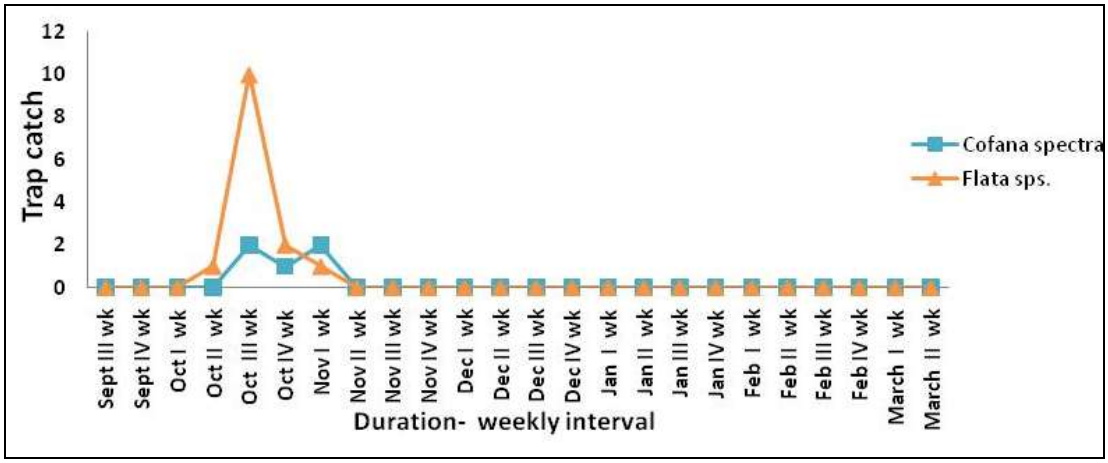

Fig 10: Seasonal activity of White Leaf hopper (*Cofana spectra*) and Hopper (*Flata sps.*)

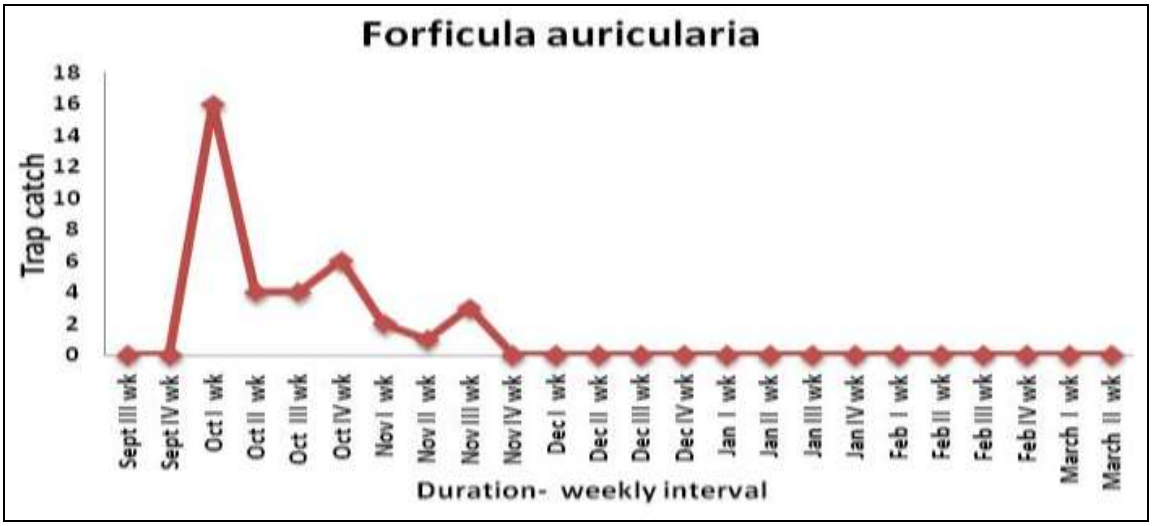

Fig 11: Seasonal activity of Earwig (*Forficula auricularia*)

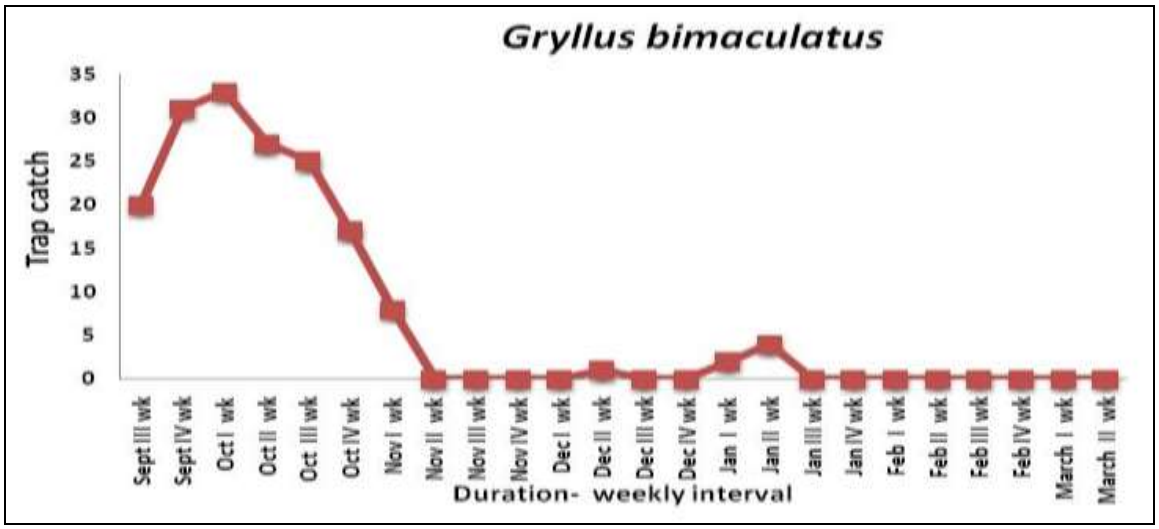

Fig 12: Seasonal activity of Field cricket (*Gryllus bimaculatus*)

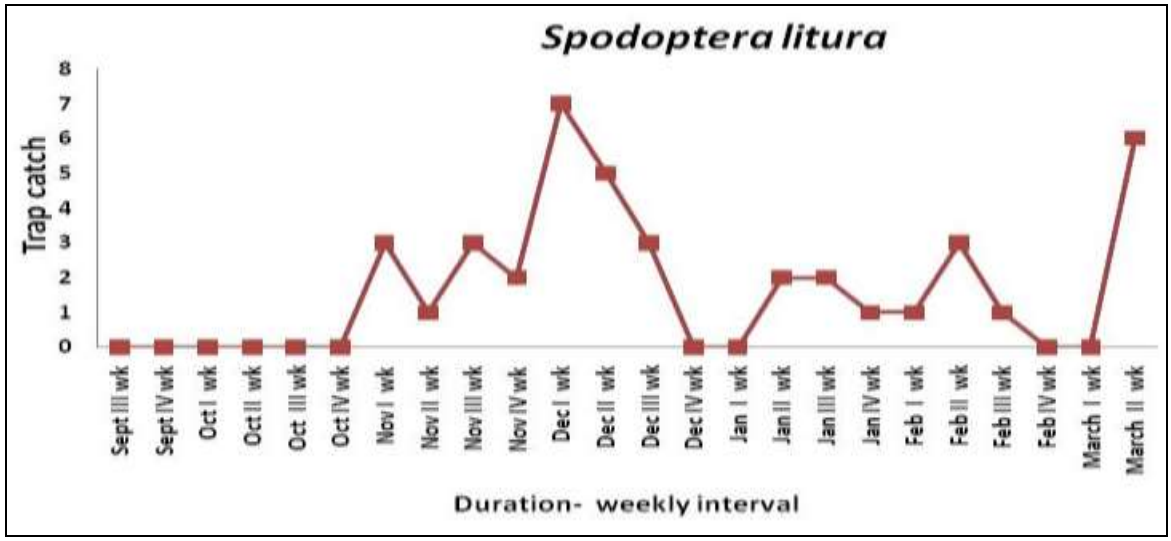

Fig 13: Seasonal activity of Tobacco caterpillar (*Spodoptera litura)*

Table 1: List of insect species collected through light trap in polyhouse during 2019-2020 (September to March)

Sr. No	Common Name	Scientific Name	Order	Family	Status
1.	Ground beetle	*Chlaenius circumdatus* (Dejean)	Coleoptera	Carabidae	Predator
2.	Ground beetle	*Ophionea indica* (Thunberg)	Coleoptera	Carabidae	Predator
3.	Water beetle	*Dytiscus marginalis* (Linnaeus)	Coleoptera	Dytisadae	Predator
4.	Ground beetle	*Brachinus longipalpis* (Wiedemann)	Coleoptera	Carabidae	Predator
5.	Ground beetle	*Chlaenius nigricans* (Riley and Clausen)	Coleoptera	Carabidae	Predator
6.	Ground beetle	*Chlaenius medioguttatis* (Chaudoir)	Coleoptera	Carabidae	Predator
7.	Lady bird beetle	*Coccinella septumpunctata*	Coleoptera	Coccinellidae	Predator
8.	Assassin bug	*Sirthenea carinata* (Fabricius)	Hemiptera	Reduviidae	Predator
9.	Earwig	*Forficula auricularia* (Linnaeus)	Dermaptera	Forficulidae	Pest
10.	Black bug	*Riptortus strenuus* (Fabricius)	Hemiptera	Coriedae	Pest
11.	Field cricket	*Gryllus bimaculatus* (De Geer)	Orthoptera	Gryllidae	Pest
12.	White Leafhopper	*Cofana spectra* (Distant)	Hemiptera	Cicadellidae	Pest
13.	Hopper	*Flata sps.* (Fabricius)	Hemiptera	Flatidea	Pest
14.	Tobacco caterpillar	*Spodoptera litura* (Fabricius)	Lepidoptera	Noctuidae	Pest

Table 2: Seasonal activity of beneficial insects collected through light Trap in polyhouse UV (8+8 watt) light source 12" Tube length.

	Species wise weekly total catch per trap (corrected to seven days)							
Observation period weekly	***Chlaenius circumdatus***	***Ophionea indica***	***Coccinella septumpunctata***	***Dytiscus marginalis***	***Brachinus longipalpis***	***Chlaenius nigricans***	***Chlaenius medioguttatis***	***Sirthenea carinata***
Sept III week	00	00	25	40	00	00	00	00
Sept IV week	12	00	26	36	00	00	00	00
Oct I week	15	00	20	23	00	1	00	00
Oct II week	12	21	16	18	00	1	00	00
Oct III week	24	13	9	21	00	00	3	2
Oct IV week	19	4	3	16	2	2	00	00
Nov I week	12	4	1	12	2	2	2	1
Nov II week	7	3	00	00	00	00	00	00
Nov III week	1	1	00	3	1	1	00	00
Nov IV week	4	00	00	1	1	00	00	00
Dec I week	4	00	00	2	1	00	1	00
Dec II week	2	1	00	00	00	1	1	00
Dec III week	00	00	00	00	00	00	00	00
Dec IV week	00	00	00	00	00	00	00	00
Jan I week	2	00	00	00	00	00	00	00
Jan II week	1	2	00	00	00	00	00	00
Jan III week	00	00	00	00	00	00	00	00
Jan IV week	4	00	00	00	4	00	1	00
Feb I week	6	00	00	00	5	00	00	00
Feb II week	2	00	00	00	00	00	00	00
Feb III week	00	00	00	00	00	00	00	00
Feb IV week	00	00	00	00	00	00	00	00
March I week	00	00	00	00	00	00	00	00
March II week	00	00	00	00	00	00	00	00
Total	127	49	100	172	16	7	8	3

Table 3: Seasonal activity of harmful species collected through light Trap in polyhouse UV (8+8 watt) light source 12" Tube length.

	Species wise weekly total catch per trap (corrected to seven days)					
Observation period weekly	***Forficula auricularia***	***Riptortus strenuus***	***Gryllus bimaculatus***	***Cofana spectra***	***Flata sps.***	***Spodoptera litura***
Sept III week	00	00	20	00	00	00
Sept IV week	00	00	31	00	00	00
Oct I week	16	00	33	00	00	00
Oct II week	4	16	27	00	1	00
Oct III week	4	17	25	2	10	00
Oct IV week	6	14	17	1	2	00
Nov I week	2	14	8	2	1	3
Nov II week	1	4	00	00	00	1
Nov III week	3	5	00	00	00	3
Nov IV week	00	1	00	00	00	2
Dec I week	00	00	00	00	00	7
Dec II week	00	1	1	00	00	5
Dec III week	00	00	00	00	00	3
Dec IV week	00	00	00	00	00	00
Jan I week	00	00	2	00	00	00

Jan II week	00	00	4	00	00	2
Jan III week	00	00	00	00	00	2
Jan IV week	00	00	00	00	00	1
Feb I week	00	00	00	00	00	1
Feb II week	00	00	00	00	00	3
Feb III week	00	00	00	00	00	1
Feb IV week	00	00	00	00	00	00
March I week	00	00	00	00	00	00
March II week	00	00	00	00	00	6
Total	36	72	168	5	14	40

Conclusion

Light trap will be helpful for insect-pest management by knowing their seasonal activities. The observations showed that mostly soil insect-pests in polyhouse were attracted towards Ultraviolet light in light trap for insect pest survey and control. Out of all species trapped, beneficial insects showed dominance in polyhouse ecosystem. The Ultra Violet light seems to be much cheaper and economic light source. Experiment show that although large number of predaceous species was collected in light trap, only few species belonging to the families Carabidae of Coleoptera and family Reduviidae of Hemiptera were of major concern. To avoid the trapping of these beneficial species, light traps can be operated selectively avoiding major active period from September to February.

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