Utility of Ultra Violet Lamp as a Light Source in Light Trap Compared to Mercury Vapour against the Insect Pest in *Kharif* Crops

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In partial fulfilment of the requirements for

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(ENTOMOLOGY)

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CERTIFICATE - I

This is to certify that the thesis entitled **"Utility of Ultra Violet Lamp as a Light Source in Light Trap Compared to Mercury Vapour Against the Insect Pest in *Kharif* Crops"** *submitted in partial fulfilment of the requirement for the degree of* ***MASTER OF SCIENCE (Ag)*** *in* ***Entomology*** *of Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur is a record of the bonafide research work carried out by* **Mr. Band Sagar Shriram, ID. No. 160119026,** *under my guidance and supervision. The subject of the thesis has been approved by the Student's Advisory Committee and the Director of Instruction.*

All the assistance and help received during the course of the investigation has been acknowledged by her.

Place: Jabalpur ....

Date:

Dr. Sanjay Vaishampayan
Chairman of the Advisory Committee

THESIS APPROVED BY THE STUDENT'S ADVISORY COMMITTEE

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CERTIFICATE – II

This is to certify that the thesis entitled **"Utility of Ultra Violet Lamp as a Light Source in Light Trap Compared to Mercury Vapour Against the Insect Pest in *Kharif* Crops"** *submitted by* **Mr. Band Sagar Shriram** *to the Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur in partial fulfilment of the requirements for the degree of* ***Master of Science*** *in* ***Agriculture*** *in the Department of* ***Entomology*** *has been, after evaluation, approved by the External Examiner and by Student's Advisory Committee after an oral examination on the same.*

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Declaration and Undertaking by the Candidate

I, **Band Sagar Shriram** S/o **Shriram Hiruji Band** certify the work embodied in the thesis entitled **"Utility of Ultra Violet Lamp as a Light Source in Light Trap Compared to Mercury Vapour Against the Insect Pest in *Kharif* Crops"** is my own first time bonafide work carried out by me under the guidance of **Dr. Sanjay Vaishampayan** at **Department of Entomology, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur during 2017-2018.**

The matter embodied in the thesis has not been submitted for the award of any other degree/diploma. Due credit has been made to all the assistance and help.

I, undertake the complete responsibility that any act of misinterpretation, mistakes, errors of fact are entirely of my own.

I, also abide myself with the decision taken by my advisor for the publication of material extracted from the thesis work and subsequent improvement, on mutually beneficial basis, provided the due credit is given, thereof.

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Place: Jabalpur

Date

Band Sagar Shriram

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CURRICULUM VITAE

The author of this thesis **Band Sagar Shriram** S/o **Shriram Hiruji Band** was born on 12 December 1994 at village- Gomedhar, Teh.- Mehkar, Distt.- Buldhana (MH).After graduation, for further study, he got admission in M.Sc. (Ag.) for specialization in Entomology at the College of Agriculture, JNKVV, Jabalpur (M.P), where successfully completed the entire course requirement for Master's degree with an OGPA 6.9 out of 10 point scale in the year 2017-18.

For the partial fulfillment of the Master's degree carried out thesis work on **"Utility of ultra violet lamp as a light source in light trap compared to mercury vapour against the insect pest in kharif crops"**. It was successfully conducted by him and being submitted in the form of this thesis.

He took admission for B.Sc. (Ag.) in Shri Shivaji Agriculture College, Amravati, Maharastra (Dr. PDKV, Akola) in the year 2012. He has successfully completed his graduation with 8.03 OGPA in the year 2016.

He passed his Higher Secondary School (12^{th}) in the year 2012 from Shri Saraswati Junior college, Janephal and High School (10^{th}) in the year 2010 from Shri Saraswati Vidyalaya, Janephal, Teh.- Mehkar, Distt. Buldhana (MH).

INTRODUCTION

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. Light trap is also used for detection of new invasions of insect pest in time and/or space, for delimitation of area of infestation, and for monitoring population levels of established pests. With the introduction of the concepts of “Integrated Pest Management” and “Economic Threshold” around 1975 and revival of non chemical methods of pest control, light trap gained a wide spread importance in Integrated Pest Management strategies in many parts of the world. Urgency was felt to use non chemical approach in pest control which is economically viable and environmentally safe. Use of light trap is one such approach in which pest control is achieved without the use of insecticides (Vaishampayan and Vaishampayan, 2016).

Light trap studies are helpful in the rational and timely application of insecticide which may lead to better and cheaper insect control with least hazards (El-Saadany, 1974). Light trap serves as an important tool to sample population of night flying insect adults very effectively. Monitoring the seasonal activity of adults particularly of ovipositing females, provide very useful information for predicting infestation level of pest in early instars stages. Light trap plays an important role in monitoring and management of insect pest population in Agro-ecosystem (Kant and Kanaujia, 2007).

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. Farmers must know that by attracting and killing one adult moth or insect they control around 300-400 insect progenies through them. 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. Once the insect population in the light traps crosses a certain limit the farmer can decide on the type of pest management they have to take up.

In apple orchards use of insecticides is prohibited. Codling moth (Cydia *pomonella*) is a serious pest in apple orchards, in Leh Laddakh, Kargil and Kashmir regions. Adult Emergence of codling moths starts as soon the winter season is over and summer season (spring season) starts. Adults are known to be strongly attracted towards UV black light lamps. Pest can be controlled very effectively using light traps in a period coincided with the emergence of first brood of codling moths during June – July and again in a following generation (Brood) coinciding with peak of adult activity. Ultra Violet 15 watt BL lamps were found to be very efficient in trapping codling moths (Madson and Sand bond 1962). Most attractive region of the spectrum was found to be between 300-400nm wavelength or near Ultra violet and violet region (Marshall and Hienton, 1935).

The response of white grubs towards various coloured light sources. Black light (UV) attracted the highest number of insects (42.1 per cent) Blue light was next attractant source (22.4 per cent) followed by white (18 per cent) in both the experiments conducted at different sites. The lowest number of insects were attracted towards red color (2.2 per cent) followed by green color (Dalvaniya, 2010).

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).The forecasting and predication of insect occurrence or outbreak can be made by using light trap (Singh *et al.* 2007).

Low wattage of ultra violet (Black light) lamps 8/10 and 15 watt with low electricity consumption, maintaining high trapping efficiency, makes these lamps most convenient to operate the light traps with solar electric panel or a set of dry recharging batteries, in the farmer's field or even in remote areas where electricity is not available.

In view of above it is proposed to test the practical use of UV light source in light traps as a substitute to MV 160 watt lamp, compared with efficiency of 8+8 watt (16 watt) UV BL lamp 12" in length as a light sources for its use in light trap.

Therefore, the present studies have been proposed with following objectives.

Objectives:

1) To study the comparative efficiency of 8+8 watt (16 watt) UV Black light lamp and 160 watt Mercury vapour lamp against major insect pest of *Kharif* crops.

2) To study the seasonal activity of major insect pest species of *Kharif* crops collected in light traps.

REVIEW OF LITERATURE

The review of literature pertaining to work done on light trap studies with reference to light sources and seasonal activity studies is presented below:

Review of work done on Mercury vapour and Ultra violet light sources-

Peterson and Haeussler (1928) conducted Laboratory investigations on the response of the Oriental fruit fly and codling moth to coloured lights during the 3 year period 1925-27. They used clear incandescent lamps combined with several color screens as attractants. Their studies showed that, if codling moths are given a choice of lights varying in color from red to violet with the relative intensities of the colored lights are approximately equal, practically all of the moths will go to blue and violet lights. Few or no adults are attracted by red lights.

Marshall and Hienton (1935) conducted experiments during the period 1933 to1934 in three sets i.e. (i) in apple orchards, (ii) in fruit packaging house and (iii) in a laboratory testing attraction of codling moths to a wide variety of lamps radiating energy in the visible and ultraviolet regions. Their early results indicated that the most attractive region of the spectrum was between 300nm and 400nm, or near ultraviolet and violet. In the packinghouse darkened during the day and with an electrocuting UV light trap, operating both day and night, more than 98% of the emerging moths were attracted and killed (Davis, 1935). The maximum catch for a single day was 15579 codling moths; and the total for the season, up to July 27 i.e. the end of the first brood emergence was 2,36,300 moths.

Ficht and Anderson (1942) compared European corn borer moth catches using six lamps of each type. Results of field tests and laboratory studies in combine indicated that the greatest radiation attraction of the European corn borer moths was in the range of 320-500 nm.

Taylor and Deay (1950) reported attraction of adult tomato and tobacco hornworms to near ultraviolet radiation between 320 and 380 nm. The attractant lamps used were germicidal, black light, and blue with maximum radiation at 253.7nm, 365nm, and 440nm, respectively of the three types of lamps used in 1948, the 360 BL lamp was outstanding in attracting of both species of hornworm moths captured by traps in open fields (92.6% catch).

Bell (1955) conducted studies on 21 commercially available electric lamps, radiating in parts of the spectrum from the ultraviolet through the infrared as attractants for moths of the tomato and tobacco hornworm species. He concluded that five of the lamps, with high radiation outputs between 320 and 400nm, were more attractive.

Pfrimmer (1955) conducted studies during 1954 to compare the responses of different orders of insects to three sources of BL radiation namely; a 15 watt BL lamp, a 15 watt BLB lamp and three 2 watt argon glow lamps. The BLB trap caught twice as many insects as the BL and about 12 ½ times as many as the argon trap. Although the bollworm response to the BL lamp was greater than to the BLB, and much greater than to the argon lamps.

Glick and Hollingsworth (1955) conducted laboratory tests in 1953 with 28 lamps or combination of lamps having radiation output that covered regions of the electro-magnetic spectrum between 184.9nm (ozone lamp) and 1200nm (infrared drying lamp). Of the several sources tested, only one single lamp proved to be more effective than the 15 watt BL fluorescent lamp a 100 watt spot type, mercury vapor lamp (H100-SP) equipped with a filter which transmitted primarily in the near ultraviolet region. The principal radiation from this lamp is in the near ultraviolet region of the spectrum. Lamps that had their principal radiation in the visible portion of the spectrum attracted fewer moths.

Glick *et al.* (1956) studied on the attraction of pink bollworm moths, verified the greater response to lamp that radiated in the near ultraviolet (black light) region. Laboratory investigations on the spectral response characteristics of pink bollworm moths were conducted by Hollinworth in 1957, 1958, and 1959. The peak response was indicated at approximately 515 nm (green). Decreased response occurred in the vicinity of 415 nm and then a secondary peak response occurred in the near ultraviolet region at about 365 nm.

Pfrimmer (1957) observed the response of insects, i.e. the cabbage looper to different sources of black light. He used a 15-w. BL and a 15-w. BLB lamp in traps similar in design to that developed by Hollingsworth for insect surveys. The third trap used was a 100-w mercury vapor lamp. During both the years, the BL lamp attracted the greatest number of moths, with the mercury vapor lamp second highest in 1955 and lowest in 1956.

Parencia *et al.* (1962) collected cabbage looper moths at Waco, Texas, in a light trap for a period of 6-years during 1956-61. The light trap used in 1956 and 1957 was of horizontal, gravity–unidirectional type with 100 watt mercury vapor lamp. Annual cabbage looper moth catches were 49,863 in 1956 and 9,902 in 1957 by the mercury vapor lamp trap. Similar catches by the trap with BL lamp varied from 15,018 to 25,336 during 1958-61. Moths were usually collected beginning in April and ending in November, with maximum catches in August.

Madsen and Sandborn (1962) observed a funnel-type trap with a 15 watt BL lamp was very efficient in trapping codling moths. The codling moth was one of the species added to USDA' s weekly Cooperative Economic insect report in 1963, when then number of insect species included in the list of those collected in light traps was increased from 9 to 20. Thus, there is international acceptance of the use of light as a determinant of codling moth activity.

Falcon *et al.* (1967) as observed in a 1966 test, black light insect trap effectively trapped moths of cabbage lopper and bollworm in a Fresno county cotton field. Increased collections of moths in the traps were followed by a rise in egg and larva populations in the field. Light trap information used together with established field checking procedures can aid in determining the need for control measures of these pests.

Graham *et al.* (1971) conducted a study on corn earworm control in corn with a rather dense installation of BL traps in Guemez, Tamaulipas, Maxico, during 1966-67. An installation of 79 suction type traps, with one

15watt BL lamp was made in an irrigated field of approximately 20 ha. The traps were placed at intervals of about 200 ft. through the cultivated area. They reported that such an installation of light traps is not useful for protecting an individual field of corn from damage by the corn earworm.

Khattab (1975) reported that when a ultra-violet light trap equipped with a 125 watt lamp was used to monitor adult populations of *Spodoptera littoralis* (a serious pest of cotton, berseem, vegetables and many other species) at Giza, Egypt, throughout 1970. Populations found to be largest in September and smallest in January. Males were consistent common in collections than females.

As reported by Vaishampayan and Verma (1983) the efficiency of various light sources in attracting night-flying adults of *Heliothis armigera* (Hubner), *Spodoptera litura* (Boisd) and *Agrotis ipsilon* (Hufn) was tested in the field during 1977-1978 in paired tests. The light sources were mercury vapor lamps of 125 and 250 watt, UV 15 Watt, Tube light and fluorescent tube light of 40 watt, in shades of white, blue, green, yellow and red, incandescent tungsten lamp of 150 and 300 watt and petromax lamp of 400 candle power. Mercury vapor and UV proved the best light sources while, Incandescent tungsten was the least effective. Blue light radiation in 450-480nm wavelength band proved a more attractive source than green, yellow and red. Mercury vapor lamp of 125 watt was as good as that of 250 watts. Trap catches in petromax light were higher than catches in incandescent light. The response to ultra violet light was higher in October and November than in February and March.

Patel *et al.* (1987) conducted studies on the management of Gujarat hairy caterpillar, *Amsacta moorei* (But.) using ultra violet light trap in groundnut crop in Gujarat, India, during 1981-83. The traps were installed at the rate of 11/10 ha. 7/8 ha and 8/10 ha in 1981, 1982 and 1983, respectively. The first adults were trapped 5, 3 and 7 days after the monsoon showers in 1981, 1982 and 1983, respectively. In 1981 and 1982, 98.7 and 84.1% of the total catch respectively over 12 days was made in the first 5 days, while in 1983 73.6% of the catch was made in the first 6 days. The mean larval population was 20.42-72.25 and 144.5-396.6 individuals per 300 square feet in area with and without light traps, respectively, in 1981. The larval population in 1982 was drastically lowered at 8.49 to11.9 and 18.99 to 24.66 individuals per 300 square feet, this was a result of the large catch in 1981.

Mohanraj *et al.* (1989) reported that the effectiveness of a mercury vapour light trap and a ultra-violet light trap in capturing rice pests was compared in the field in Tamil Nadu, India. The former trap collected 40% of all specimens and the later 33%. The stem borer, brown plant hopper and green leaf hopper were more attracted to the mercury than to the ultraviolet light trap.

Abens and Khan (1990) tested different light colors (ultraviolet, violet, blue, green, yellow, orange, red and white) for their effectiveness in monitoring rice leaf hoppers and plant hoppers in an irrigated rice field at Laguna, Philippines, in 1988 wet season. White light attracted significantly more individuals of the brown plant hopper (*Nilaparvata lugens*), white backed plant hopper (*Sogatella furcifera*) and green leaf hopper (*Nephotettix virescens*) than lights of the other colours. Yellow was the second most effective light colour.

Ashfaq *et al.* (2005) studied the effect of different colors on light trap catches and the lights of six different colors were blue, green, yellow, red, black and white. The highest number of insects was observed in container placed under the black light (UV light), while the lowest in that of red light. The common insect orders frequented among all color lights were, Dipteral, Coleoptera, and Lepidoptera. Mercury light was more effective for Lepidoptera, Hemiptera, Hymenoptera, Odonata and Diptera while black light was more efficient for Coleoptera, Orthoptera, Isoptera and Dictyoptera.

Hogsette (2008) observed significant difference in performance between the open and closed trap housings. The open trap is significantly more efficacious in collecting flies when operated with the BL bulbs. The closed trap captured numerically fewer flies than the open trap with the BL bulbs, but closed BLB was more flies attractive than the open trap when trap operated with BLB bulb.

Dalvaniya (2010) tested the response of white grubs towards various coloured light sources. Black light (UV) attracted the highest number of insects (42.1 per cent) Blue light was next attractant source (22.4 per cent) followed by white (18 per cent) in both the experiments conducted at different sites. The lowest number of insects were attracted towards red color (2.2per cent) followed by green colour.

Ramamurthy *et al.* (2010) conducted field trial during 2007-08 at the IARI, New Delhi for studying the effect of three light sources in light trap catches (*viz.,* mercury, black and ultra violet) on insect. Results revealed the mercury vapor light was more efficient for Lepidoptera, Hemiptera, Hymenoptera, Odonata, and Diptera and black light was more efficient for Coleoptera, Orthoptera, Isoptera and Dictyoptera.

Shimoda and Honda (2013) reported insects are able to see ultraviolet (UV) radiation. Nocturnal insects are often attracted to light sources that emit large amounts of UV radiation.

Pyae *et.al*. (2016) reported the importance of UV light traps which caught 2960 individuals representing 481 species belonging to 10 orders across 10 sites on JJ and 7080 individuals representing 769 species in14 orders across10 sites on six insect orders namely Lepidoptera, Coleoptera, Diptera, Hemiptera, Hymenoptera and Trichoptera were dominant in both areas.

Review of general seasonal activity of insect pest of crops

Pruthi (1969) as well as Rechards and Davies (1980) reported field crickets spp. and their damage to many cultivated crops as soil pests damaging roots. The species were collected on light traps in sufficiently high numbers throughout the year. The major active period of *Gryllotalpa* was from August to April with highest activity during October, November and January. The major active period of *Gryllus* spp. was for June to October and again in March, April and May.

Mohanraj *et al.* (1989) tested the sex ratio and reproductive status of the rice *Scirpophaga incertulas* and *Cnaphalocrocis medinalis* in an ultraviolet light trap in Tamil Nadu, India. More females than males of *S.*

incertulas were captured in which 58.6% of females were gravid. The sex ratio of *C. medinalis* was more or less equal were as 61% of females were gravid.

Vaishampayan and Singh (1996) observed the activity of cabbage semilooper *Plusia orichalcea* on light trap catches during the period 1991-92 in which 1992-93 Rabi season at Varanasi. The activity of pest was low to medium in January and February was recorded. (Monthly catch-34 and 277 moths). Whereas very least population in March (64,566 moths).

Bhatnagar and Saxena (1999) studied the effect of climate on the population buildup of rice insect pests using light traps in Jagdalpur, India, for over 4 years (1994-97). They reported that *Leptocorisa acuta* (Thunberg) had a significant negative correlation with minimum temperature, evening relative humidity & rainfall and a positive correlation with sunshine hours and maximum temperature.

Rathore (2001) conducted studies on seasonal activity of field cricket and mole cricket by using the light trap in vegetable farm at Jabalpur (M.P.). The seasonal activity was recorded from September to October. Highest monthly catches were recorded during September for both the insects (320 crickets).

Akbulut *et al*. (2003) recorded a total of 109 species belonging to 17 families of the order Lepidoptera by using light traps at Duzce, Turkey. The family Geometridae was represented by the highest number of species (20) followed by Noctuidae (19), Lycaenidae (12) and Nymphalidae (12).

Sharma *et al.* (2004) reported the seasonal activity of paddy pests by using light trap at Jabalpur, M.P. They observed that major activity period of rice butterfly, *Melanitis leda ismene* Cramer was from July to August and peak period was observed during September, while the major activity period of field crickets was from July to October with maximum population in July.

Khan and Ramamurthy (2004) conducted studies on rice leaf folder population dynamics in rice fields at New Delhi, India during June to November from 1997 to 2000 by using light trap. They revealed that the moth numbers were higher in the month of October, exhibiting peak activity in the first week, followed by September.

Dangi (2004) observed that *Spodoptera litura* (Fabricius)*, Helicoverpa armigera* (Hubner), Agrotis *ipsilon* (Hufnagel) and *Plusia orichalcea* (Fabricius) as polyphagous pests of family Noctuidae and *Amsacta moorei* Butler & *Spilosoma obliqua* Walker of family Arctiidae were the major species collected in light trap at Jabalpur during 2003 to 2004.

Sharma *et al.* (2006) observed the highest trap catch of *Plusia acuta* Fabricius (1367 moths) followed by *Hyblaea puera* Cramer (962 moths), *Polytela gloriosae* Fabricius (546 moths), *Mythimna separata* (Walker) (483 moths) and *Plusia orichalcea* Fabricius (383 moths) with a total of 13 species of family Nocuidae. *Cnaphalocrocis medinalis* (Guenee) was observed in highest numbers (8,665 moths) among all the Lepidopterous species in paddy ecosystem during kharif season at Jabalpur.

Kathirvelu and Manickavasgam (2007) reported the influence of weather factors on light trap catches of pest complex of rice field during July 2005 to June 2006. The pests such as stem borer, leaf folder, brown plant hopper (BPH) and green leaf hopper (GLH) were recorded during the 35th, 11th, 33rd and 35th SW respectively. The leaf folder had significant negative correlation with maximum temperature and significant positive correlation with sunshine. Minimum temperature and wind velocity were non-significant and negatively correlated with skipper. Hoppers such as BPH and GLH were positively correlated with maximum and minimum temperature, sunshine and rainy days.

Singh *et.al* (2007) reported that the nocturnal Orthopterous were collected by means of light trap and the population fluctuations of twenty four species of orthopterans were correlated with temperature and relative humidity. In all six families viz. Gryllidae, Gryllotalpidae, Tettigoniidae (belonging to Suborder Ensifera) and Acrididae, Tridactylidae, and Tetrigidae (belonging to Suborder Caelifera) were collected from different locations of Punjab. Gryllidae was found dominant followed by Tetrigidae compared to other families.

Cameron *et al.* (2008) reported that soybean looper, *Thysanoplusia orichalcea* (Plusiinae: Noctuidae) moths were first intercepted in New

Zealand in 1984 by light trapping that was being used as a surveillance tool for new lepidopteran pests in particular, noctuid species from Australia.

Keresi and Almasi (2009) studied a total of 179,031 specimens belonging to 177 species and 14 families through light trap catches at northern Serbia. The most abundant species belonged to Noctuidae (54.9%), Pyralidae (27.4%) Geometridae (8.3%) and Arctiidae (6.1%) families. Within Pyralids, the dominant species were *Ostrinia nubilalis* (Hubner) and *Margaritia sticticalis* (Linnaeus), within Geometrids, they recorded three major species namely *Tephrina arenacearia* (Denis et Schiffermuller), *Chiasmia clathrata* (Linnaeus) and *Ascotis selenaria* (Denis et Schiffermuller).

Venkatesh *et al.* (2009) conducted experiments during *kharif* of 2006 and summer of 2007 to study the occurrence and intensity of paddy earhead bug *Leptocorisa acuta* (Thunberg) in different rice growing tracts of Bhadra command area. Monitoring of earhead bug by using light trap indicated that higher activity of earhead bug was noticed during summer i.e in the month of April-May and also in kharif i.e in the month of September-October in which synchronized with flowering and milking stages of the crop.

Nowinszky and Puskas (2009) observed the light-trap catch of all the five species was low in full moon period. Whereas in case of the yellow wooly bear (*Spilosoma virginica* (Fabr.) the forage looper (*Caenurgina erechtea* Cramer), and the western bean cutworm (*Striacosta albicosta* Smith) a maximum catch was detectable in the vicinity of a new moon.

Sharma and Vaishampayan (2009) observed 27 species from 8 families of order Lepidoptera in light trap catch at Jabalpur using 125 watt mercury vapour lamp. Among these family Noctuidae was the largest including 13 species. The major polyphagous pest species of this family were *Helicoverpa armigera* (120 moths), *Agrotis ipsilon* (84 moths) and *Spodoptera litura* (246 moths). Comparing the relative size of trap catches, the largest catch was observed in case of *Cnaphalocrocis medinalis* (7,988 moths) belonging to family Pyralidae which was a major pest of paddy in this region. Other major Lepidopteron paddy pest species were *Mythimna separata* (466) and *Melanitis ismene* (122).

Hakyemez and Hzal (2010) using light trap studied in Kapdag Peninsula during 2006 and 2007. A total of 35 Noctuidae species of 12 different subfamilies were collected and identified.

Metzler *et al.* (2010) conducted studies on Lepidoptera, especially the moths trapping and observed that many species of moths were captured in black-light traps including *Cisthene perrosea* (Dyar) (Erebidae) and *Tolype mayelisae* Franclemont (Lasiocampidae) from New Mexico for the first time.

Hafeez *et al.* (2010) reported that adults of leaf folder were found in light trap catches during 26^{th} SW and reached its highest peak in 33^{rd} SW. Correlation coefficient between abiotic parameters and light trap catches revealed that only mean relative humidity (r=0.793) and minimum temperature (r=0.513) had a significant positive effect on trap catches.

Bernardi *et al.* (2011) reported that a total catch of two thousand and twenty individuals collected in light trap belonging to 14 families, 106 genera and 220 species. The families with the highest number of species collected were Noctuidae (59), Geometridae (30), Arctiidae (28) and Saturniidae (14).

Stojanovic *et al.* (2011) recorded 48 species of potentially harmful Noctuidae species during the 3-year research period (2007-2009). While using different light trap models within the National park "Djerdap", North-East Serbia.

Shubhalaxmi *et al.* (2011) studied on light trap collection and observed that a total of 418 species from 28 families belonging to 15 superfamilies, were recorded at eight sites in northern Western Ghats, India and they reported that the dominant families were Erebidae, Geometridae, Sphingidae and Crambidae.

Wang *et al.* (2012) monitored the activity of mole cricket (*Gryllotalpa* sp.) by using light trap and reported that it had two damage peaks (late May to early July, early September to mid and late October) through light trap catches.

Rai *et al.* (2013) tested the novel technologies for the management of white grubs in lower hills of new Himalayan region on community basis involving use of an efficient, light weight light trap for capturing the adults (beetles) and an entomo-pathogen *Bacillis cereus* for the management of grubs.

Sharma and Bisen (2013) reported that a total of 56 species were recorded in light trap using mercury vapour lamp, during *kharif* season (2006), Among these, 23 species of 7 families belonged to order Lepidoptera in vegetable cropping area at Jabalpur. They also reported trapping of rice army worm, *Mythimna separata* as a major pest of paddy.

Muchhala (2014) observed *Acherontia styx* (Westwood) (13 moths) and *Agrius convolvuli* (Linnaeus) (298 moths) of family Sphingidae and *Euproctis similis* (155 moths) and *Psalis pennatula* (15 moths) of family Lymentridae in light trap collection highest trap catch of family arctiidae was observed in case of tiger moth, *Creatonotos gangis* (Linnaeus) (1275 moths) collected in light trap catches in paddy ecosystem at Jabalpur during *kharif* season 2013.

Parra et al. (2014) reported that the family Noctuidae as most diversified group of Lepidoptera of major economic importance because of the detrimental activity of the larvae. A total of 28 species were recorded by using light trap in the different study areas.

Dadmal and Khadakkar (2014) conducted experiments at PDKV Akola and investigated the species composition of insect fauna attracted towards the light trap. Observations revealed that order Coleoptera showed a rich population i.e. 41.81% and 35.10% of the total collection in 2011-12 and 2012-13 respectively followed by Hemiptera 16.86% and 21.77% and Lepidoptera 12.96% and 12.89%, respectively. 19 species of scarab beetles belonging to 10 genera were also found to be the prominent visitors in both the years. Subfamily, Melolonthinae had rich species diversity with five species of genus *Holotrichia* and *Schizomycha ruficollis*.

MATERIAL AND METHODS

Experimental site:

The experiments were conducted on the Breeding Seed farm, Adhartal, JNKVV Jabalpur (MP) during the period between last week of June to last week of October, (2017 -2018).

Geographical location and Climate:

The climatic conditions prevalent in Jabalpur are essentially semi-arid and sub-tropical. It is situated at 23.9°N latitude, 79.58° E longitude and at an altitude of 411.78 m above the mean sea level. The annual rainfall varies from 1300 to 1400 mm with an average of 1350 mm, which is mostly received during June to October from South- west monsoon. The average maximum temperature was 46 ^{0}C and minimum temperature is 6.8 ^{0}C. The average annual relative humidity is 74%.

Details of light trap unit:

Light Trap model SMV- 4 developed by Dr. S. M. Vaishampayan in 2014, were used in the present study. The details of light trap design are published in book "Light Trap: an eco friendly IPM tool" written by Vaishampayan & Vaishampayan (2016).Trap is suitable to use MV and UV lamps as light source (Plate-1 and 2). The light trap unit is comprised of two components (a) Trapping unit with funnel baffle plates and (b) a Collection unit.

The insects collected in the collection bag were killed by the exposure of Dichlorvos 76 EC vapours (as fumigating agent) released in a dispenser with scrubber, placed in a collection tray for instant killing of trapped insects. Insects were collected from the collection bag every morning.

Observation procedure:

As per the objectives of the study experiments were conducted in the field. Light traps were operated every night and collection was being observed next morning. Observations were recorded every day throughout the *Kharif* season. Total insects fauna was observed and sorted out on the basis of major species and order groups. Data of daily trap catch was maintained.

In all, two light traps were installed in the experimental area. This area was covered mainly by a soybean crop in around 30 ha of crop area. Spacing between each trap was approximately 100 meter.

Comparative efficacy of two light sources:

It includes two treatments to compare the relative efficiency of UV lamp over mercury vapor lamp as light source in a light trap in trapping and collecting insects of various crop pest species

T1 - MV (Mercury Vapor) lamp 160 watt

T2 - UV (Ultra Violet) tube 8+8 watt

Seasonal activities of major insect pests of *kharif* crops:

Study the seasonal activity of various insect pest species collected in light trap i.e a comparative study of traps operated by two light sources.

T1 - MV (Mercury Vapor) lamp 160 watt

T2 - UV (Ultra Violet) tube 8+8 watt

Seasonal activity study shall be based on total number of insect trapped per week (corrected to seven days total) in two traps. (i.e MV 160 watt and UV 8+8 watt)

Statistical method:

Comparative efficacy of two light sources:

Paired t-test for testing the significant difference between two treatments:

The data were subjected to statistical analysis after tabulation. The species wise mean per day catch per trap was computed by dividing total

Plate No.1: SMV 4 light trap model were installed in Breeding Seed Farm, JNKVV Jabalpur during *Kharif* season (2017)

SMV 4 MV 160 Watt (12"Tube)

SMV 4 UV 8+8 Watt

Close VIEW of UV 8+8 Watt (12" Tube)

trap catch with number of days of collection obtained in a week. The data so obtained were analyzed by using paired t-test as given below:

$$t = \frac{\bar{d}}{s/\sqrt{n}}$$

Where, $\bar{d} = \frac{1}{n}\sum_{i=1}^{n} d_i$, $d_i = x_i - y_i$, $i = 1,2,3 \ldots\ldots n$ and

$$s^2 = \frac{1}{n-1}\sum_{i=1}^{n}(d_i - \bar{d})^2$$

Follows student's t-distribution with (n-1) d.f.

RESULT

This chapter deals with the brief description of results obtained under different objectives of the experiment entitled **"Utility of ultra violet lamp as a light source in light trap compared to mercury vapour against the insect pest in *Kharif* crops"** The findings of the present study are described here.

The results are presented here under sub headings:

4.1 Comparative efficiency of 8+8 watt (16 watt) UV Black light lamp and 160 watt Mercury vapour lamp against major insect pest of *Kharif* crops.

4.2 Seasonal activity of major insect pest species of *Kharif* crops collected in light traps.

Table No. 4.1: Name of major species observed in trap catches.

S. No.	Common name	Scientific name	Order	Family
1.	White grub	*Holotrichia consangunia*	Coleoptera	Scarabaeidae
2.	Field cricket	*Gryllus bimaculatus*	Orthoptera	Gryllidae
3.	Mole cricket	*Gryllotalpa orienrtalis*	Orthoptera	Gryllotalpidae
4.	Teak defoliator	*Hyblaea puera*	Lepidoptera	Hyblaeidae
5.	Soybean semilooper	*Plusia chalcites*	Lepidoptera	Noctuidae
6.	Tobacco caterpillar	*Spodoptera litura*	Lepidoptera	Noctuidae
7.	Bihar Hairy caterpillar	*Spilosoma obliqua*	Lepidoptera	Arctiidae

For analysis purpose, the species wise mean per day catch per trap (Treatment) were computed in experiment No.1 (as shown in table. No 4.2) for comparison of efficiency of light sources, the observation data were analyzed following standard statistical procedure (Paired t-test for testing the

Plate No.2: Major insect pest species collected in different light source

Order: Coleoptera Order: Orthoptera

Family- Scarabaeidae **Family- Gryllidae**

C.N: White grub **C.N: Field cricket**

Holotrichia consangunia* (Hope)** ***Gryllus bimaculatus
(De Geer)

Order: Orthoptera **Order:**
Lepodoptera

Family- Gryllotalpidae **Family-**
Hyblaeidae

C.N: Mole cricket **C.N: Teak**
defoliator

Gryllotalpa orienrtalis* (Burmeister)** ***Hyblaea puera
(Cramer)

Order: **Lepidoptera**
Lepidoptera

Family - **Noctuidae**
Noctuidae

Order:

Family -

C.N: Soybean Semilooper caterpillar

***Plusia chalcites* (Esper)**
(Fabricius)

C.N: Tobacco

Spodoptera litura

Order: **Lepidoptera**

Family - **Arctiidae**

C.N: Bihar Hairy caterpillar

Spilosoma obliqua (Walker)

significant difference between two treatments). Experiment wise results are presented below-

4.1 Comparative efficiency of 8+8 watt (16 watt) UV Black light lamp and 160 watt Mercury vapour lamp against major insect pest of *kharif* crops

Results of experiment on comparative responses of insect pest species towards light sources are described in brief below

Experiment: I

Treatments -

T1 - MV (Mercury Vapor) lamp 160 watt

T2 - UV (Ultra Violet) tubes 8+8 watt (12'' length)

Note – Comparison is based on species wise mean per day catch per trap

Period – 4th week of June to Last week of October (2017)

Observations of Experiment No.1

Table No.4.2: Comparative response of insect pest species towards light sources.

T1-MV 160 watt, T2-UV 8+8 watt.

Sr. No.	Observation period weekly	Species wise mean per day catch per trap							
		Holotrichia consangunia		*Gryllus bimaculatus*		*Gryllotalpa orientalis*		*Hyblaea puera*	
		T1	T2	T1	T2	T1	T2	T1	T2
		MV 160 W	UV 8+8 W	MV 160 W	UV 8+8 W	MV 160 W	UV 8+8 W	MV 160 W	UV 8+8 W
1	Jun IV wk	1.57	2.85	165.71	254.86	2.43	2.14	0	0
2	Jul I wk	5.71	5.29	76.43	90.29	3.57	2.85	10.14	13.43
3	Jul II wk	4	5.5	142.63	208.75	6.75	2.25	36	43.5
4	Jul III wk	0	0	1401.67	459	10	3	89.5	70.33
5	Jul IV wk	0	0	193.29	213.86	2.57	3.14	38.57	69.71
6	Aug I wk	0	0	103.83	26.33	3.17	2.5	3.5	3
7	Aug II wk	0	0	100.43	100.28	4.57	6	12.14	12.14
8	Aug III wk	0	0	94.71	58.42	3.86	3.43	9.14	7.29
9	Aug IV wk	0	0	94.14	69.71	3.29	3.14	0	0
10	Sept I wk	0	0	84.17	79.33	10.33	6.83	0	0
11	Sept II wk	0	0	106.29	53.29	19.71	5.71	0	0
12	Sept III wk	0	0	122	109.83	4.33	5.33	0	0
13	Sept IV wk	0	0	122.5	62.25	40.75	13.75	0	0
14	Oct I wk	0	0	76.57	124.29	13.71	9	0	0
15	Oct II wk	0	0	100.13	89.25	18.5	9.25	0	0
16	Oct III wk	0	0	108.57	84.57	11.14	9.71	0	0
17	Oct IV wk	0	0	77	73.11	9.78	12.22	0	0

Sr.No.	Observation period weekly	Species wise mean per day catch per trap					
		Plusia chalcites		*Spodoptera litura*		*Spilosoma obliqua*	
		T1	T2	T1	T2	T1	T2
		MV 160 W	UV 8+8 W	MV 160 W	UV 8+8 W	MV 160 W	UV 8+8 W
1	Jun IV wk	0	0	0	0	0	0
2	Jul I wk	0	0	0	0	0	0
3	Jul II wk	0	0	0	0	0	0
4	Jul III wk	0	0	3.33	4.5	0	0
5	Jul IV wk	0	0	9.43	5.57	0	0
6	Aug I wk	17.83	18	4.17	3.17	5.67	6.0
7	Aug II wk	21.71	19.29	4.57	2	4.57	3.14
8	Aug III wk	27	21.42	3.57	4	6.14	3.57
9	Aug IV wk	24.14	20.43	9	6.29	4.14	3.28
10	Sept I wk	31	13.83	9.33	3.67	11.0	10.67
11	Sept II wk	19.86	11.86	15.86	8.71	15.0	6.43
12	Sept III wk	27.17	16.83	9.5	7.67	10.17	11.16
13	Sept IV wk	24.62	12.13	8.38	4.5	5.13	5.25
14	Oct I wk	5.29	6.71	7.57	3.57	5.86	4.57
15	Oct II wk	11.63	8.13	6.88	5.13	2.13	3.50
16	Oct III wk	3.71	4.85	4.14	6.85	1.71	2.57
17	Oct IV wk	4.56	5.56	6.89	4.89	3.22	3.44

Species wise comparative response given below-

1. White grub *Holotrichia consangunia* (Hope)

$H_0 : \mu_1 = \mu_2$

$H_1 : \mu_1 \neq \mu_2$

Details of statistics with light sources MV and UV	*Holotrichia consangunia*	
	T1	T2
	MV 160 watt	UV 8+8 watt
No. of Observation	3	3
Total mean	3.76	4.54
Variance	4.33	2.17
d.f	2	
t_{cal}	1.297 (NS)	
$t_{tab\ (0.05)}$	4.303	

NS (non significant)

Conclusion

- The calculated value of t (1.297) is found to be less than the tabulated value (4.303) of t (2 df) at 5% level of significance. Hence, we accept the null hypothesis and conclude that there is no significant difference between mean of MV 160 Watt and UV 8+8 Watt.
- Numerically trap catch was higher in UV than MV.

2. Field cricket *Gryllus bimaculatus* (De Geer)

$H_0 : \mu_1=\mu_2$

$H_1 : \mu_1\neq\mu_2$

Details of statistics with light sources MV and UV	***Gryllus bimaculatus***	
	T1	**T2**
	MV 160 watt	**UV 8+8 watt**
No. of Observation	**17**	**17**
Total mean	**186.48**	**126.91**
Variance	**99070.23**	**11206.94**
d.f	**16**	
t_{cal}	**1.060 (NS)**	
$t_{tab\ (0.05)}$	**2.12**	

NS (non significant)

Conclusion

- The calculated value of t (1.060) is found to be less than the tabulated value (2.12) of t (16 df) at 5% level of significance. Hence, we accept the null hypothesis and conclude that there is no significant difference between mean of MV 160 Watt and UV 8+8 Watt.
- Numerically trap catch was higher in MV than UV.

3. Mole cricket *Gryllotalpa orienrtalis* (Burmeister)

$H_0 : \mu_1 = \mu_2$

$H_1 : \mu_1 \neq \mu_2$

Details of statistics with light sources MV and UV	*Gryllotalpa orienrtalis*	
	T1	T2
	MV 160 watt	UV 8+8 watt
No. of Observation	17	17
Total mean	9.91	5.90
Variance	92.66	13.51
d.f	16	
t_{cal}	2.265*	
$t_{tab\ (0.05)}$	2.12	
$t_{tab\ (0.01)}$	2.921	

*Significant at 5%

Non significant at 1%

Conclusion

- The calculated value of t (2.265) is found to be greater than the tabulated value (2.12) of t (16 df) at 5% level of significance. Hence, we reject the null hypothesis and conclude that there is significant difference between mean of MV 160 Watt and UV 8+8 Watt.
- Numerically trap catch was higher in MV than UV.

4. Teak defoliator *Hyblaea puera* (Cramer)

$H_0 : \mu_1 = \mu_2$

$H_1 : \mu_1 \neq \mu_2$

Details of statistics with light sources MV and UV	*Hyblaea puera*	
	T1	T2
	MV 160 watt	UV 8+8 watt
No. of Observation	7	7
Total mean	28.43	31.34
Variance	913.86	868.55
d.f	6	
t_{cal}	0.515 (NS)	
$t_{tab\ (0.05)}$	2.447	

NS (non significant)

Conclusion

- The calculated value of t (0.515) is found to be less than the tabulated value (2.447) of t (6 df) at 5% level of significance. Hence, we accept the null hypothesis and conclude that there is no significant difference between mean of MV 160 Watt and UV 8+8 Watt.
- Numerically trap catch was higher in UV than MV.

5. Soybean semilooper *Plusia chalcites* (Esper)

$H_0 : \mu_1 = \mu_2$

$H_1 : \mu_1 \neq \mu_2$

Details of statistics with light sources MV and UV	*Plusia chalcites*	
	T1	T2
	MV 160 watt	UV 8+8 watt
No. of Observation	12	12
Total mean	18.21	13.25
Variance	92.66	35.67
d.f	11	
t_{cal}	2.868*	
$t_{tab\ (0.05)}$	2.201	
$t_{tab\ (0.01)}$	3.106	

*Significant at 5%

Non significant at 1%

Conclusion

- The calculated value of t (2.868) is found to be greater than the tabulated value (2.201) of t (11 df) at 5% level of significance. Hence, we reject the null hypothesis and conclude that there is significant difference between mean of MV 160 Watt and UV 8+8 Watt.
- Numerically trap catch was higher in MV than UV.

6. Tobacco caterpillar *Spodoptera litura* (Fabricius)

$H_0 : \mu_1 = \mu_2$

$H_1 : \mu_1 \neq \mu_2$

Details of statistics with light sources MV and UV	*Spodoptera litura*	
	T1	T2
	MV 160 watt	UV 8+8 watt
No. of Observation	14	14
Total mean	7.33	5.04
Variance	11.396	3.38
d.f	13	
t_{cal}	3.265**	
$t_{tab\ (0.05)}$	2.16	
$t_{tab\ (0.01)}$	3.012	

****Significant at 5% and 1%**

Conclusion

- The calculated value of t (3.265) is found to be greater than the tabulated value (2.16) of t (13 df) at 5% level of significance. Hence, we reject the null hypothesis and conclude that there is significant difference between mean of MV 160 Watt and UV 8+8 Watt.
- Numerically trap catch was higher in MV than UV.

7. Bihar Hairy caterpillar *Spilosoma obliqua* (Walker)

$H_0 : \mu_1 = \mu_2$

$H_1 : \mu_1 \neq \mu_2$

Details of statistics with light sources MV and UV	***Spilosoma obliqua***	
	T1	**T2**
	MV 160 watt	**UV 8+8 watt**
No. of Observation	**12**	**12**
Total mean	**6.29**	**5.30**
Variance	**15.48**	**8.30**
d.f	**11**	
t_{cal}	**1.210 (NS)**	
$t_{tab\ (0.05)}$	**2.201**	

NS (non significant)

Conclusion

- The calculated value of t (1.210) is found to be less than the tabulated value (2.201) of t (11 df) at 5% level of significance. Hence, we accept the null hypothesis and conclude that there is no significant difference between mean of MV 160 Watt and UV 8+8 Watt.
- Numerically trap catch was higher in MV than UV.

Graphical representation of relative responses of various insect pest species towards light sources tested during *Kharif* season 2017-18

Experiment I

(a) Period – 4th week of June to Last week of October (2017)

(b) Light sources tested: (No. of treatment – 2)

T1 - MV (Mercury Vapor) lamp 160 watt

T2 - UV (Ultra Violet) tube 8+8 watt (12'' length)

Species wise response presented in figure-1.1 to 1.7

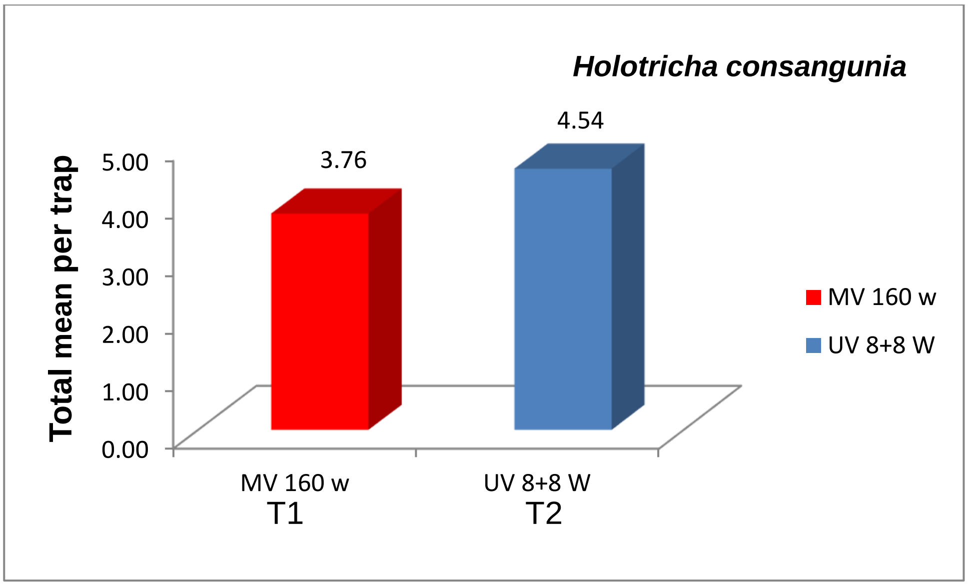

Figure 1.1: Response of white grub (*Holotrichia consangunia)*

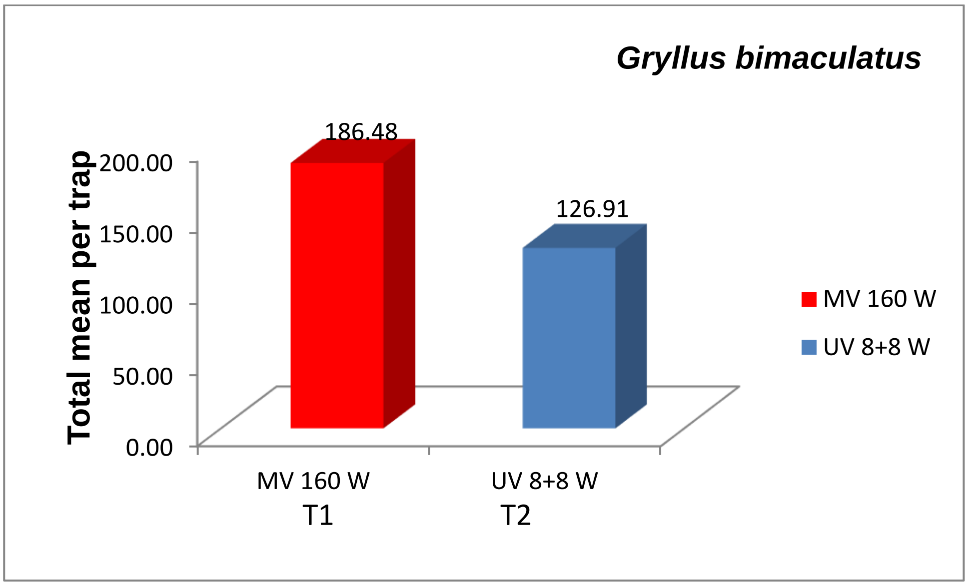

Figure 1.2: Response of field cricket (*Gryllus bimaculatus)*

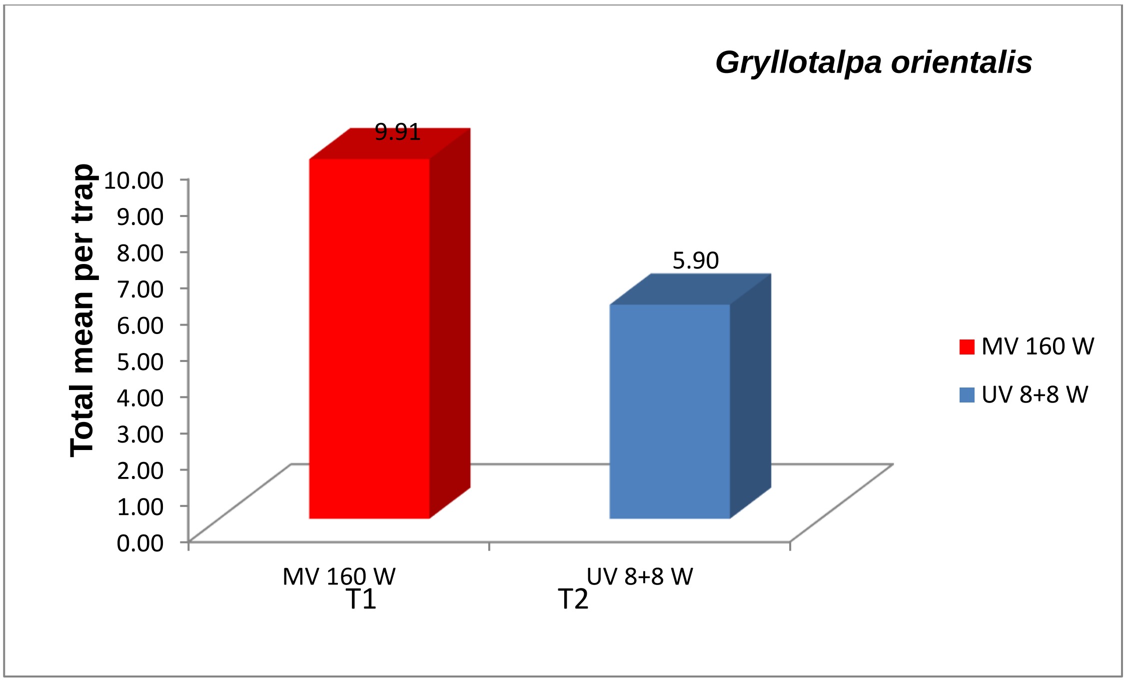

Figure 1.3: Response of mole cricket (*Gryllotalpa orientalis)*

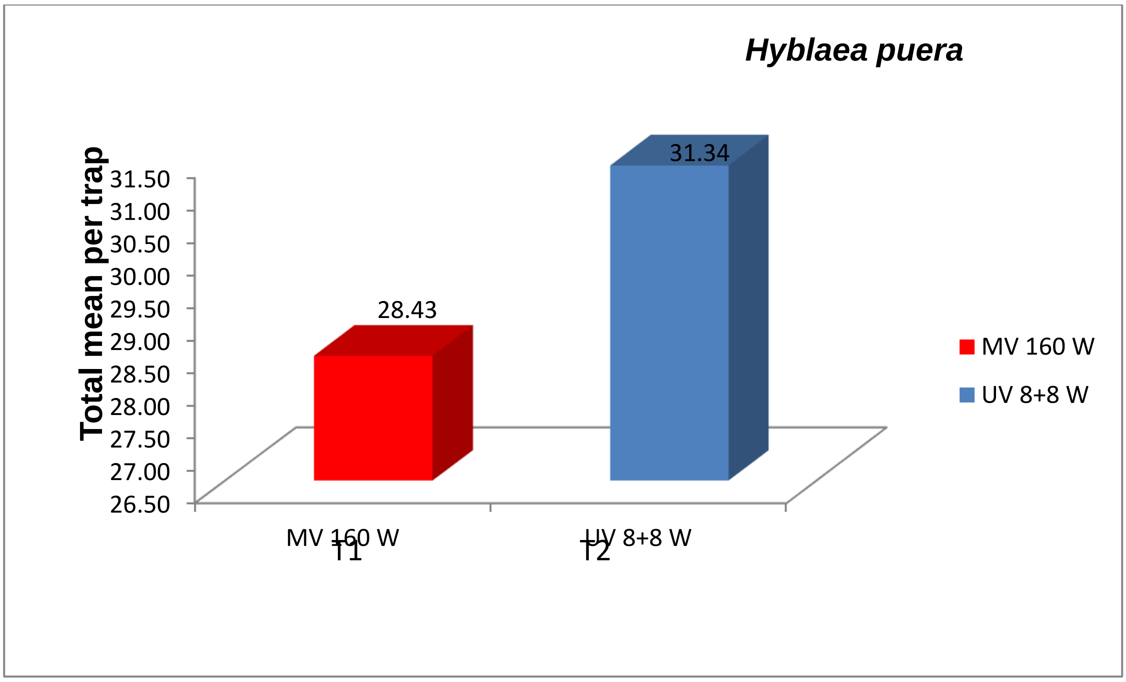

Figure 1.4: Response of teak defoliator (*Hyblaea puera)*

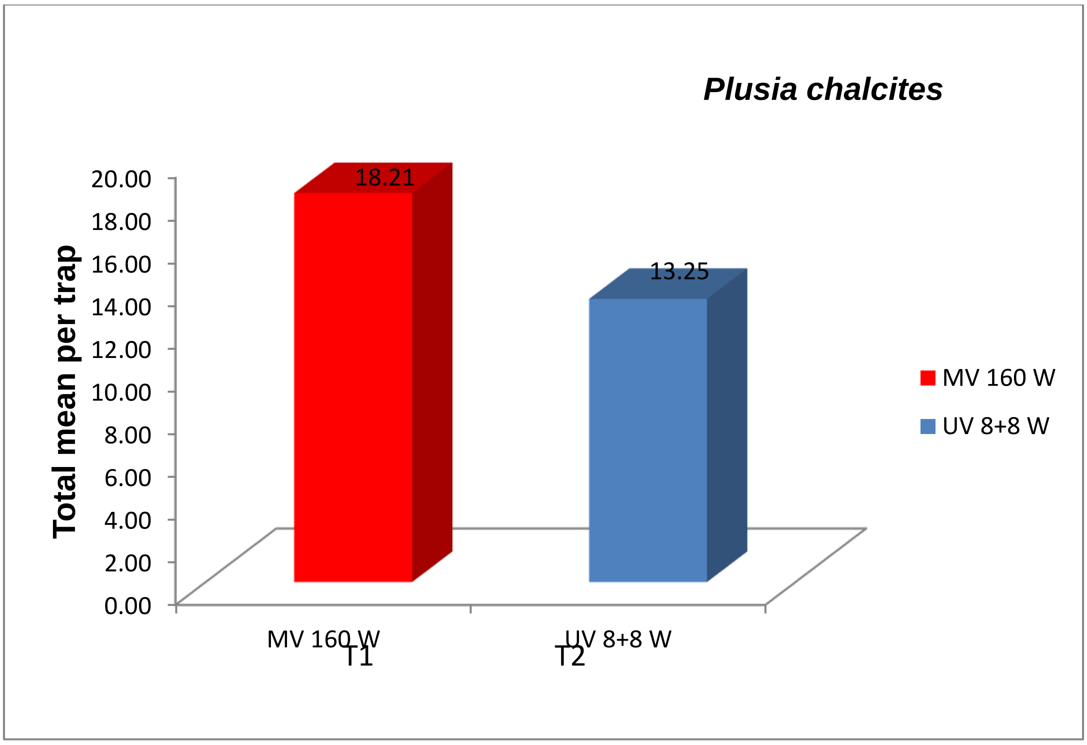

Figure 1.5: Response of soybean semilooper (*Plusia chalcites*)

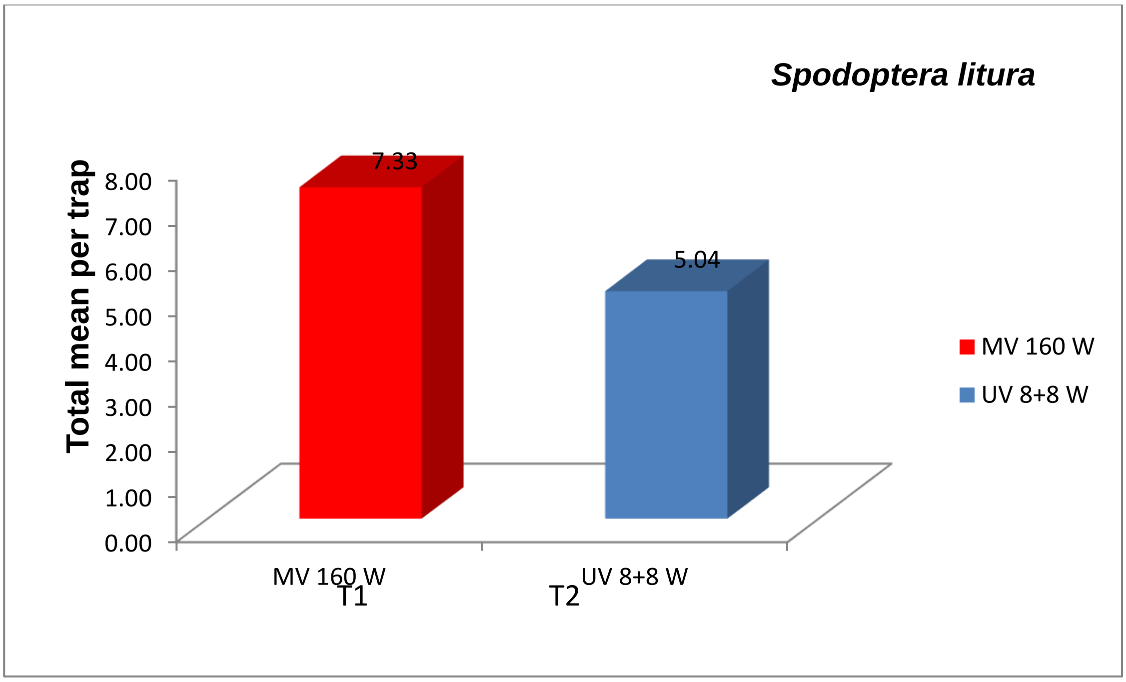

Figure 1.6: Response of tobacco caterpillar (*Spodoptera litura*)

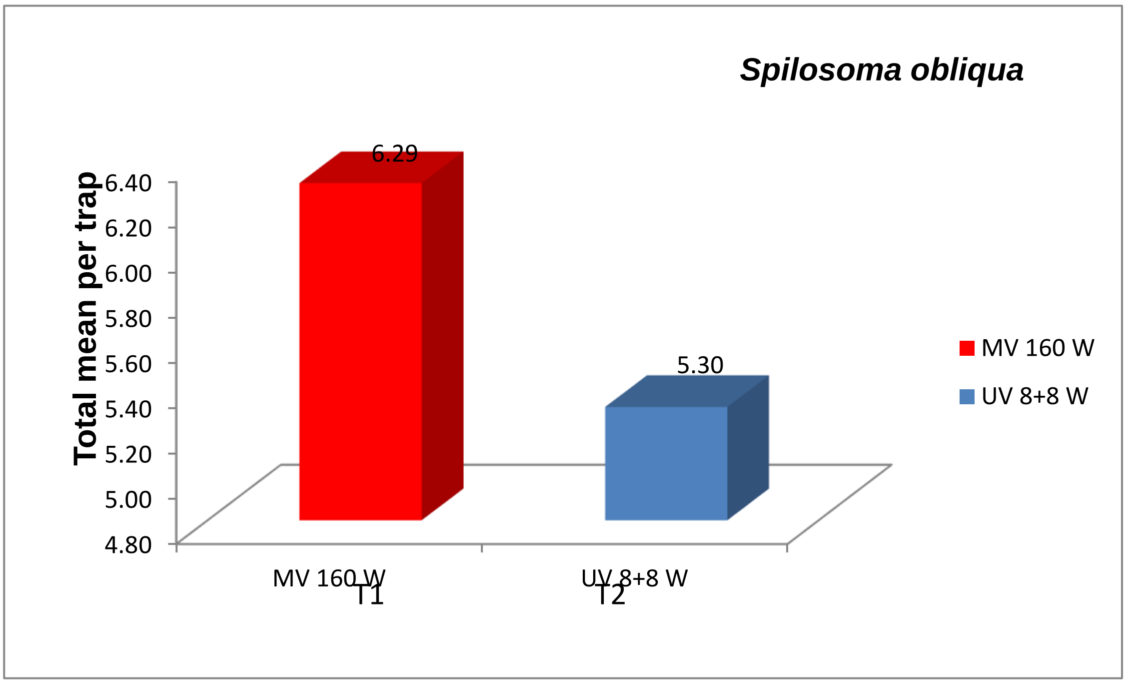

Figure 1.7: Response of Bihar hairy caterpillar (*Spilosoma obliqua*)

4.2 Seasonal activity of major insect pest species of *Kharif* crops collected in light traps.

Seasonal activities of major insect pest species of *Kharif* crops (Table no. 1) collected in light trap were studied by operating light trap with MV 160 watt and UV 8+8 watt light sources. The experiments were conducted on the Breeding seed farm, Adhartal, JNKVV Jabalpur (MP) during the period between last week of June to last week of October, (2017 -2018). Soybean was the principle crop grown on the farm in light trap area. Record of daily collection of insect species of *Kharif* crops based on our experience occurring regularly throughout the season was maintained. The data of every day catch of major insect pest of *Kharif* crops collected in trap were converted to weekly total (corrected to seven days) in Table. No.4.3. In all, 7 major species of crop pests were observed in the *Kharif* crop ecosystem, having regular occurrence in light trap catches which have been listed in Table No.4.1

Experiment: II

Treatments -

T1 - MV (Mercury Vapor) lamp 160 watt

T2 - UV (Ultra Violet) tube 8+8 watt (12'' length)

Note – Seasonal activity data is based on weekly total of trap catch / week (Corrected to 7 days),

Period – 4th week of June to Last week of October (2017)

Observations of Experiment No.2

Table number 4.3: - Seasonal activities of insect pest species towards light sources.

OBSERVATION PERIOD	Species wise weekly total catch/trap (corrected to seven day)							
	Holotrichia consangunia		*Gryllus bimaculatus*		*Gryllotalpa orientalis*		*Hyblaea puera*	
	T1	**T2**	**T1**	**T2**	**T1**	**T2**	**T1**	**T2**
	MV 160 w	UV 8+8w	MV 160 w	UV 8+8w	MV 160 w	UV 8+8w	MV 160 w	UV 8+8w
Jun IV wk	11	20	1160	1784	17	15	0	0
Jul I wk	40	37	535	632	25	20	71	94
Jul II wk	28	39	998	1461	47	16	252	305
Jul III wk	0	0	9812	3213	70	21	627	492
Jul IV wk	0	0	1353	1497	18	22	270	488
Aug I wk	0	0	727	184	22	18	25	21
Aug II wk	0	0	703	702	32	42	85	85
Aug III wk	0	0	663	409	27	24	64	51
Aug IV wk	0	0	659	488	23	22	0	0
Sept I wk	0	0	589	555	72	48	0	0
Sept II wk	0	0	744	373	138	40	0	0
Sept III wk	0	0	854	769	30	37	0	0
Sept IV wk	0	0	858	436	285	96	0	0
Oct I wk	0	0	536	870	96	63	0	0
Oct II wk	0	0	701	625	130	65	0	0
Oct III wk	0	0	760	592	78	68	0	0
Oct IV wk	0	0	539	512	68	86	0	0
Total	**79**	**96**	**22191**	**15102**	**1178**	**703**	**1394**	**1536**

OBSERVATION PERIOD	Species wise weekly total catch/trap (corrected to seven day)					
	Plusia chalcites		***Spodoptera litura***		***Spilosoma obliqua***	
	T1	**T2**	T1	T2	**T1**	**T2**
	MV 160 w	UV 8+8w	MV 160 w	UV 8+8w	MV 160 w	UV 8+8w
Jun IV wk	0	0	0	0	0	0
Jul I wk	0	0	0	0	0	0
Jul II wk	0	0	0	0	0	0
Jul III wk	0	0	23	32	0	0
Jul IV wk	0	0	66	39	0	0
Aug I wk	125	126	29	22	40	42
Aug II wk	152	135	32	14	32	22
Aug III wk	189	150	25	28	43	25
Aug IV wk	169	143	63	44	29	23
Sept I wk	217	97	65	26	77	75
Sept II wk	139	83	111	61	105	45
Sept III wk	190	118	67	54	71	78
Sept IV wk	172	85	59	32	36	37
Oct I wk	37	47	53	25	41	32
Oct II wk	81	57	48	36	15	25
Oct III wk	26	34	29	48	12	18
Oct IV wk	32	39	48	34	23	24
Total	**1529**	**1114**	**718**	**495**	**524**	**446**

1. **White grub (*Holotrichia consangunia*)**

White grub is a sporadic pest of many agricultural crops and teak seedlings in forest nurseries, severely damaging root systems of host plants during August and September in many parts of India.

The pest was active with the onset of monsoon. Activity started in June IV wk at low level. Population reached at its peak in July I wk and declined sharply in July III wk. No activities were seen from July III week and onward up to the end of the October in both the light traps. Weekly catches of pest population varied between 10–40 white grubs. (Fig.2.1)

Population trend in seasonal activity, showed one peak in July I wk in MV as well as in UV light source (40 and 37 grubs) respectively, while another additional peak was observed in UV light source in July II wk (39 grubs). Population was little higher in UV compared to MV.

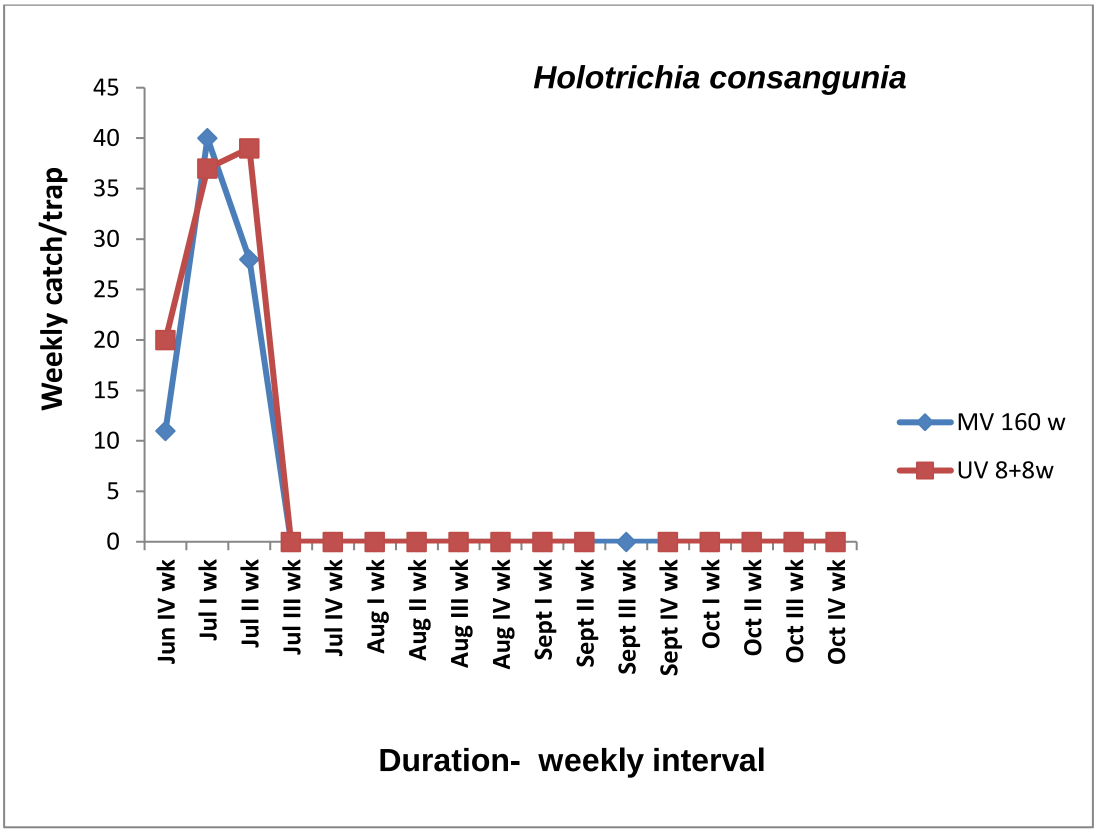

Figure No. 2.1: Seasonal activity of white grub (Holotrichia consangunia) monitored by light trap catch.

2. Field cricket (*Gryllus bimaculatus*)

Very little is known about the status of these species as a pest of agricultural crops. Field crickets are known to damage many cultivated crops as soil pest damaging roots.

Pest was active throughout the *Kharif* season from June IV wk to October end. Activity started in June IV wk at low level. Population reached at its peak in July III wk and declined sharply in July IV wk. In MV light source, peak was distinctly higher (9812 crickets) compared to UV light source (3213 crickets). The pest population was considerably low during rest of the period up to October IV wk, remained almost at the same level in both the light sources. Weekly catch of pest population varied between 500-800 crickets. (Fig. 2.2)

Population trend in seasonal activity, showed only one peak appearing in July III wk, in both the light sources i.e MV and UV. Population was distinctly higher in MV compared to UV in this period.

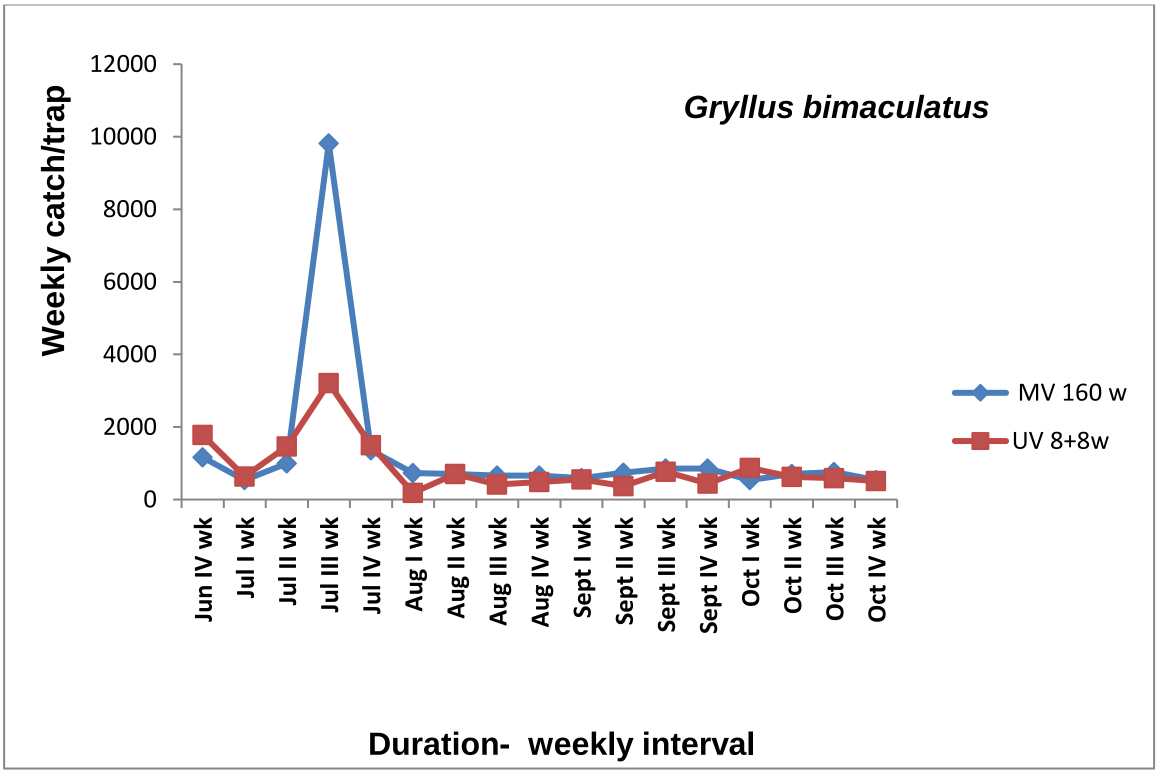

Figure No. 2.2: Seasonal activity of field cricket (*Gryllus bimaculatus*) monitored by light trap catch.

3. **Mole cricket (*Gryllotalpa orienrtalis*)**

Very little is known about the status of these species as a pest of agricultural crops. Mole cricket is known to damage many cultivated crops as soil pest damaging the root.

Pest was active throughout the *Kharif* season from June IV wk to October end. Activity started in June IV wk at low level. Population reached at its peak in September IV wk in both the light sources. There were four distinct peaks in the population in MV light source appearing first in July III wk, second in September II wk, third in September IV wk and fourth in October II wk with catch of 70, 138, 285 and 130 mole crickets respectively. Weekly catch of pest population varied between 15-285 mole crickets.

In case of UV light source three peaks were observed first in August II wk, second in September I wk and third in September IV wk with catch of 42, 48 and 96 mole crickets respectively. Population at highest peak in UV light source was however, very low compared to MV light source 96 and 285 mole crickets respectively. Population level was considerably higher in MV compared to UV light source. (Fig. 2.3)

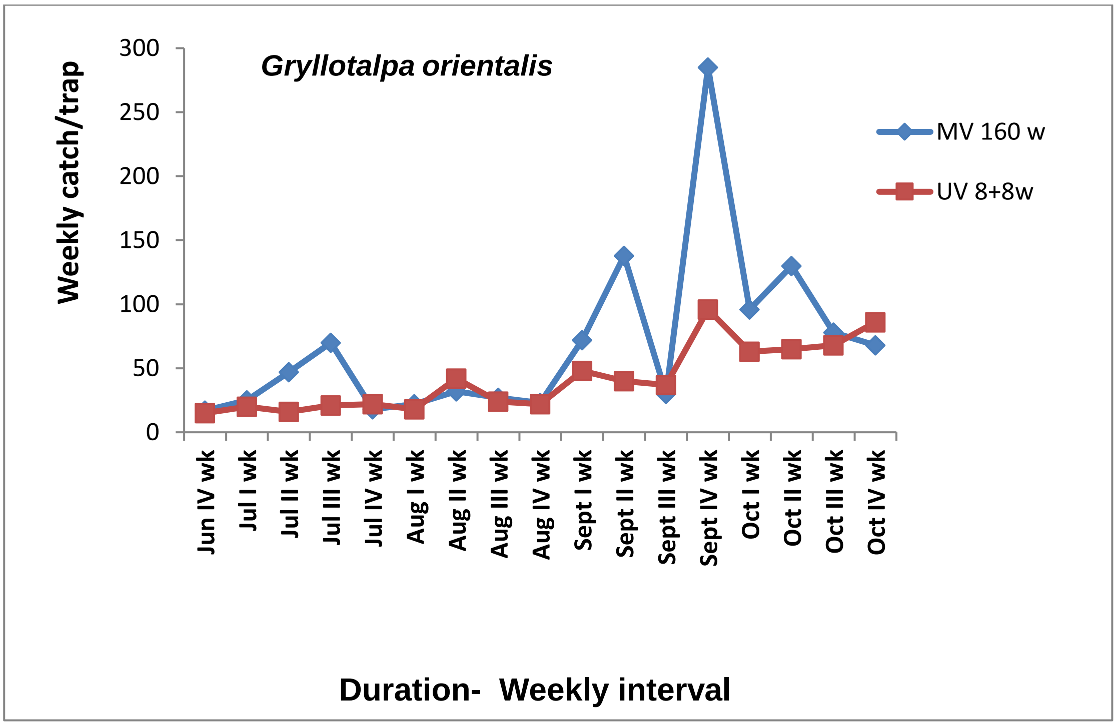

Figure No. 2.3: Seasonal activity of mole cricket (*Gryllotalpa orientalis*) monitored by light trap catch.

4. Teak defoliator (*Hyblaea puera*)

It is a serious defoliator pest of teak and active during July and August. Pest was active during the *Kharif* season from July I wk to August III wk. Activity started in July I wk at low level. Population reached at its peak in July III wk in both the light traps. i.e MV (627 moths) and UV (492 moths) and declined onwards July IV wk till August III wk. Weekly catch of pest population varied between 21-627 moths.

Population trend in seasonal activity, with one peak in July III wk, was almost similar in both the light sources i.e MV and UV. Another additional peak was observed in UV light only in July IV wk (488 moths). Small peak was observed in August II wk in both the light sources i.e MV (85 moths) and UV (85 moths). Pest disappeared onward August IV wk. The overall response was however higher in UV light compared to MV light source. (Fig. 2.4)

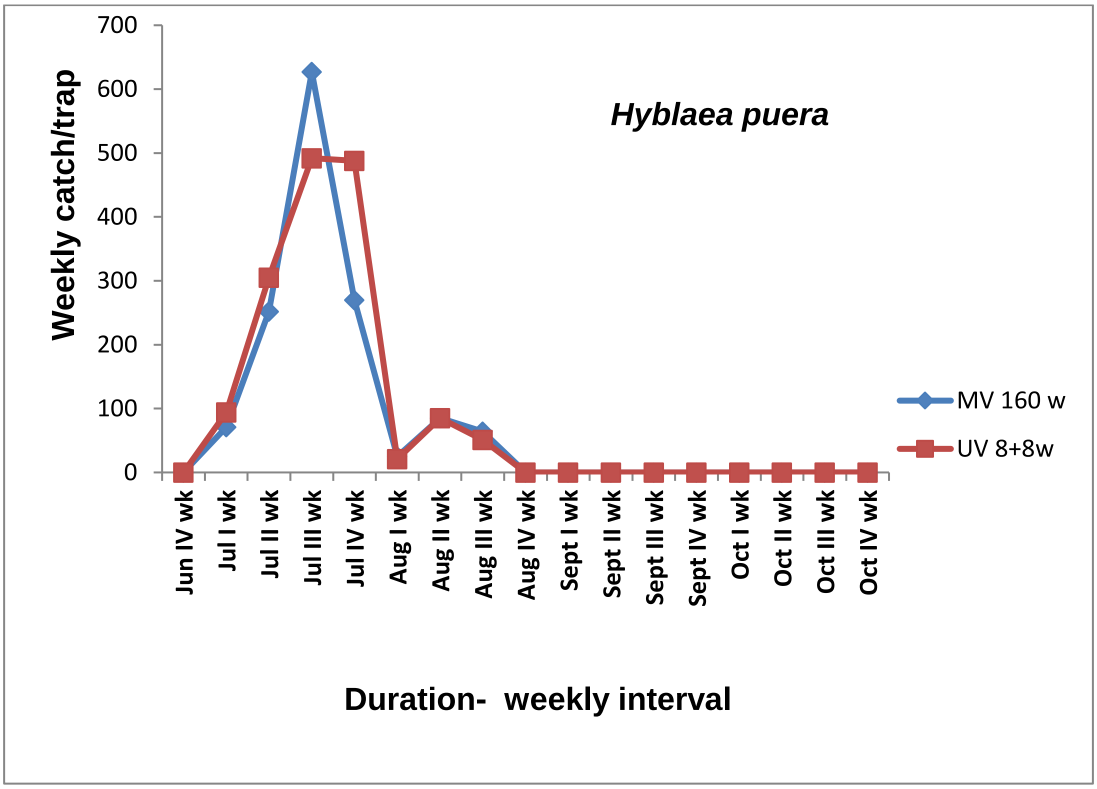

Figure No. 2.4: Seasonal activity of teak defoliator (*Hyblaea puera*) monitored by light trap catch.

5. Soybean semilooper (*Plusia chalcites*).

It is a major pest of many *Kharif* pulses including soybean. Pest was active during the kharif season from August I wk to October end. Activity started in August I wk. Initially no activity was seen from June IV wk to July IV wk. Population reached at its highest peak in September I wk in MV light source (217 moths). Weekly catch of pest population varied between 26-217 moths.

Population trend in seasonal activity, showed four peaks appearing first in August III wk (189 and 150 moths) second and third peak in September I wk (217 and 97) and III wk (190 and 118 moths) respectively. Fourth peak was observed at low level in October II wk 81 and 57 moths) in both the light sources Population was considerably higher in MV compared to UV. (Fig. 2.5)

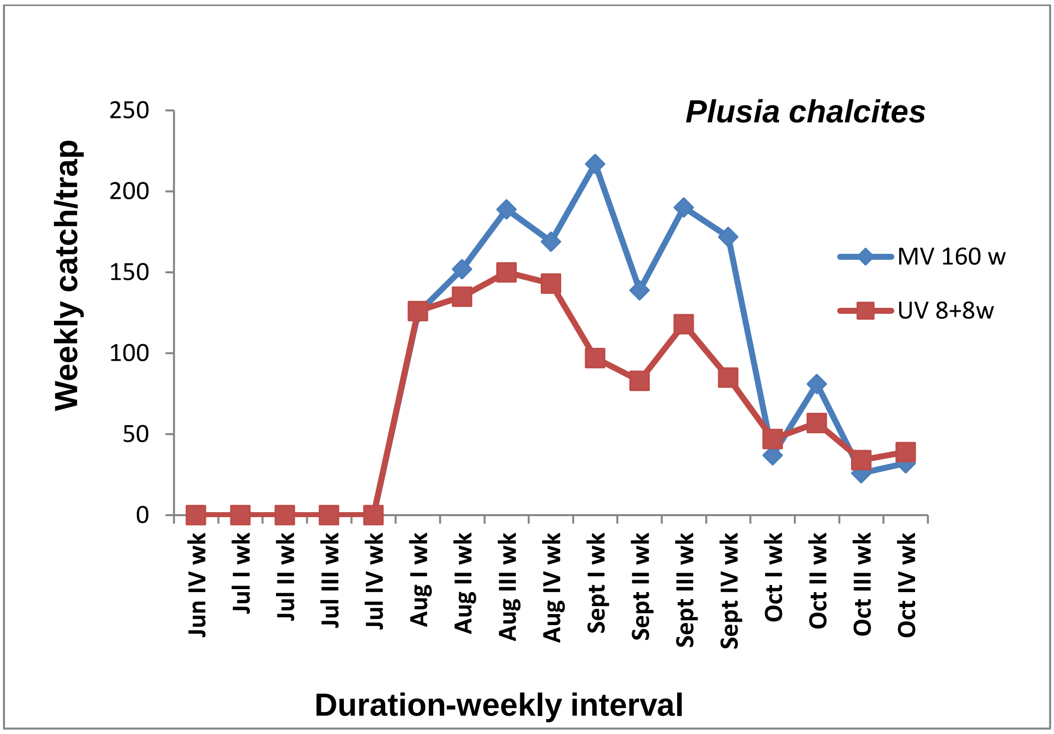

Figure No. 2.5: Seasonal activity of soybean semilooper (*Plusia chalcites*) monitored by light trap catch.

6. Tobacco caterpillar (*Spodoptera litura*)

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, urid and soybean.

Pest was active during the *Kharif* season from July III wk to October end. Activity started in July III wk at low level. Initially no activity was seen from June IV wk to July II wk. Population reached at its peak in September II wk in MV and UV with catch of 111 and 61 moths respectively. Weekly catch of pest population varied between 20-120 moths.

Population trend in seasonal activity, showed three peaks appearing first in July IV wk (66 and 39 moths), second in August IV wk (63 and 44 moths) and third highest peak in September II wk (111 and 61 moths) in both the light sources i.e MV and UV respectively. Population was considerably higher in MV compared to UV. (Fig. 2.6)

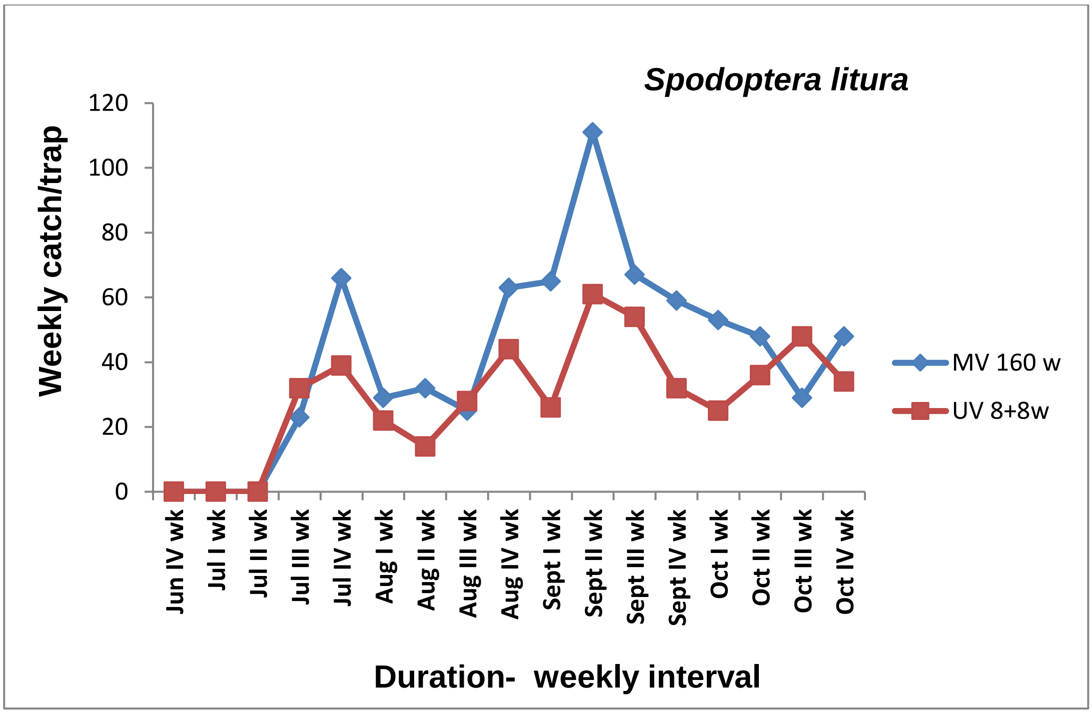

Figure No. 2.6: Seasonal activity of tobacco caterpillar (*Spodoptera litura*) monitored by light trap catch.

7. Bihar hairy caterpillar (*Spilosoma obliqua*)

It is a polyphagous pest attacking sunflower, castor, cotton, greengram, bengalgram, maize and sunhemp. It is a major pest of sunflower.

Pest was active during the *Kharif* season from August I wk to October end. Activity started in August I wk. Initially no activity was seen from June IV wk to July IV wk. Population reached at its peak in September II wk (105 moths) in MV light source. The pest was active from August I wk to October end almost at the same level. Weekly catch of pest population varied between 12-105 moths.

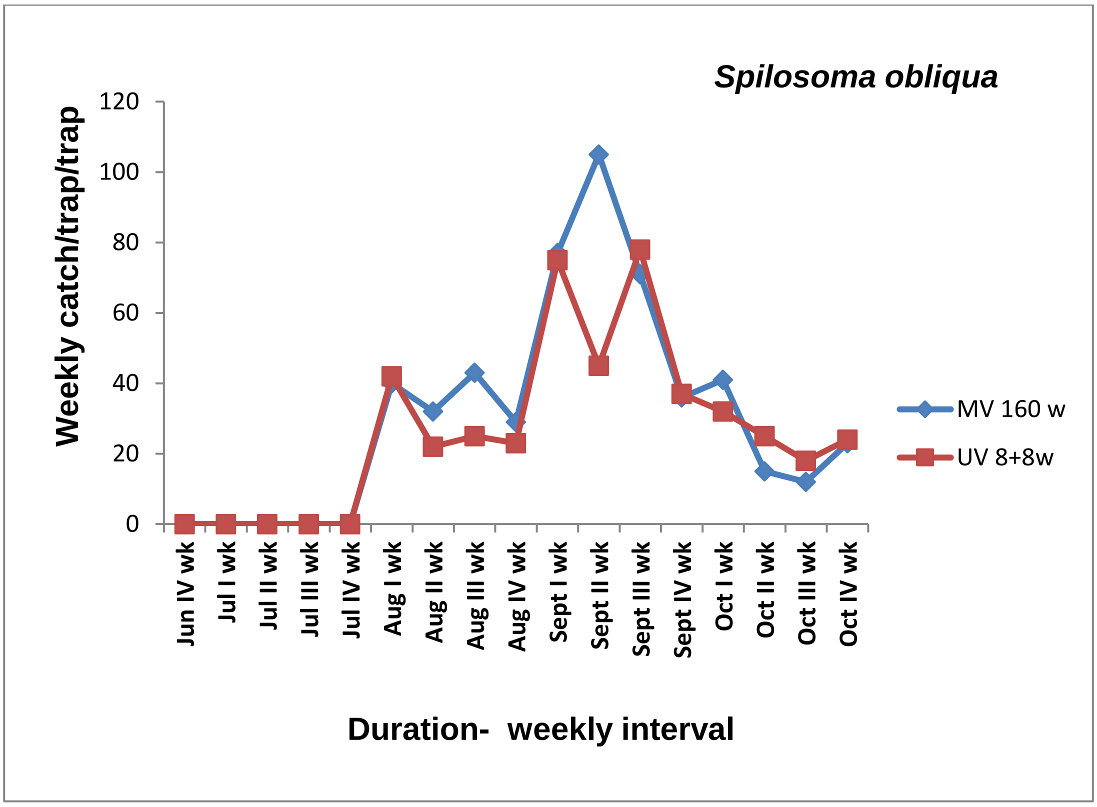

Figure No. 2.7: Seasonal activity of bihar hairy caterpillar (*Spilosoma obliqua*) monitored by light trap catch.

Population trend in seasonal activity, showed three peaks first in August III wk, second in September II and third in October I wk in MV light source 43, 105, 41 respectively. In case of UV light source also three peaks were observed first in August I wk (42 moths). Another two peaks were observed at highest level (almost at same level) in September I and III wk with the catch of 75 and 78 moths respectively. Population was almost at same level in MV and UV both with the exception of difference in September II wk. (Fig. 2.7)

Table no. 4.4: Order wise monthly observation data number of insect pest species collected in light traps in Breeding Seed Farm, JNKVV Jabalpur during 2017.

Sr. No.	Name of Order	Total catch/ Trap (Treatment)									
		June		July		August		September		October	
		MV 160 wt	UV 8+8 wt	MV 160 wt	UV 8+8 wt	MV 160 wt	UV 8+8 wt	MV 160 wt	UV 8+8 wt	MV 160 wt	UV 8+8 wt
1	Lepidoptera	140	122	1032	1013	1651	1698	1163	1223	1528	1657
2	Hemiptera	51	43	512	439	875	689	528	457	194	156
3	Coleoptera	35	28	1123	1056	1561	1352	917	871	522	641
4	Orthoptera	5	9	23	19	63	57	76	60	17	28
5	Hymenoptera	0	0	21	14	10	18	17	19	8	11
6	Odonata	12	18	16	13	22	19	8	5	18	14
7	Neuroptera	0	0	15	21	11	7	19	15	24	20
8	Diptera	11	8	45	32	46	39	21	16	28	34
9	Dermaptera	0	0	5	3	15	11	24	27	14	9
10	Dictyoptera	0	0	3	3	9	10	4	6	5	3

DISCUSSION

The Mercury vapour lamp and Ultraviolet light are the well known light sources used in light trap for survey and monitoring of insect pest. Mercury vapour lamp, because of its high wattage (power consumption) and difficulties in installation, heavy weight of chock and expenses in fitting etc. UV light seems to be much cheaper and economic light source than MV source. Present investigations were carried out to keep in mind to test our hypothesis if MV can be replaced satisfactorily by UV (15 to 16) watt light source, maintaining the trapping efficiency almost at same level in majority of insect pest species.

The principle objective of the present studies was to test the comparative efficiency of 8+8 watt (16 watt) UV Black light lamp and 160 watt Mercury vapour lamp against major insect pest of *Kharif* season.

In addition to this comparision observations were also made on utility of UV light source in light trap operation for study the seasonal activity of the major insect pest species during the study period June last week to October 2017.

The present investigations were carried out by installing two light traps in the experimental site covered by soybean and other Kharif crops. The light sources were UV Black light lamp (8+8 watt) and MV (160 watt). Overall results of experiments showed that UV Black light lamp (8+8 watt) when used in light trap have given good response in terms of light trap catches, compared to MV lamp.

Silent findings of the work done are described below:

5.1 Comparison of UV 8+8 watt (16 watt) V/S MV 160 watt:

Comparison is based on the relative response of the insect pest species (mean per day catch per trap) in two light sources i.e UV and MV. Statistically analyzed by Paired t-test. Results are summarized in three head as given below:

1. Higher response in UV compared to MV: (Statistically non significant)

The species showing higher response in UV are listed below:

1. White grub, *Holotrichia consangunia* (Coleoptera)

2. Teak defoliator, *Hyblea puera* (Lepidoptera)

In above two species numerically (by number of trap catch), UV 8+8 watt (16 watt) has given higher response i.e better than MV 160 watt, but statistically, differences were non significant in the trap catch of these two species.

2. Lower response in UV compared to MV: (Statistically non significant)

The species showing lower response in UV are listed below:

1. Field cricket, *Gryllus bimaculatus* (Coleoptera)

2. Bihar hairy caterpillar, *Spilosoma obliqua* (Lepidoptera)

In above two species numerically (by number of trap catch), MV 160 watt has given higher response than UV 8+8 watt, but statistically, differences were non significant in the trap catch of these two species.

3. Lower response in UV compared to MV: (Statistically significant)

The species showing lower responses in UV are listed below:

1. Mole cricket, *Gryllotalpa orientalis* (Orthoptera)
2. Soybean semilooper, *Plusia chalcites* (Lepidoptera)
3. Tobacco caterpillar, *Spodoptera litura* (Lepidoptera)

In above species numerically (by number of trap catch), UV 8+8 watt has given lower response than MV 160 watt. Statistically their differences were significant at 5% level of significance in all the three species.

Therefore, taking into consideration the relative response, lower wattage consumption, trap catches etc UV 8+8 light source seem to be much cheaper and economic light source and a very good substitute to MV 160 watt as a pest control, survey and monitoring device.

Economy in electricity consumption in straight away 90% (160 watt vs 16 watt).

Results of experimental work done on light trap studies earlier (Since 1935) in many parts of USA and other countries, support the importance of Ultra violet light, specially the 15 watt black light (UV) lamp (18'' tube) as a light source for its use in light trap as survey and pest control tool. The salient findings of the work done as discussed by Vaishampayan and Vaishampayan 2016 have been summarized, in brief below-

As reported by Vaishampayan and Verma (1983) the efficiency of various light sources in attracting night-flying adults of *Heliothis armigera* (Hubner), *Spodoptera litura* (Boisd) and *Agrotis ipsilon* (Hufn) was tested in the field during 1977-1978 in paired tests. Mercury vapor followed by UV proved the best light sources.

Dalvaniya (2010) tested the response of white grubs towards various coloured light sources. Black light (UV) attracted the highest number of insects (42.1 per cent) Blue light was next attractant source (22.4 per cent) followed by white (18 per cent) in both the experiments conducted at different sites.

Taylor and Deay (1950) reported the attraction of adult tomato and tobacco hornworms to near ultraviolet radiation between 320 and 380 nm. The attractant lamps used were germicidal, black light and blue. The 360 BL lamp was outstanding in attracting 92.6% of both species of hornworm moths captured by traps in open fields.

Bell (1955) concluded that the radiation outputs between 320 and 400nm were more attractive to moths of the tomato and tobacco hornworm species. This range includes the UV radiation. Menear (1961) found good response of tomato and tobacco hornworms were throughout the Ultraviolet region. Deay and Hartsock (1960) reported that, on an average, one trap equipped with one 15 watt BL lamp decreased the number of hornworms infested plants by 73.5 % and the amount of leaves eaten by 77.4% in an area 100 feet from the trap.

Pfrimmer (1957) observed the response of cabbage looper to different sources of black light i.e.15-watt BL and 15-watt BLB lamps compared with a 100-w mercury vapor lamp. During the years, (1955 & 1956), the BL lamp attracted the greatest number of moths. Catch in Mercury vapor lamp was second highest in 1955 and lowest in 1956.

Falcon *et* al. (1967) observed that in black light insect trap effectively trapped moths of cabbage lopper and bollworm in a Fresno county cotton field. Increased collections of moths in the traps were followed by a rise in egg and larva populations in the field.

Marshall and Hienton (1935) studied that attraction of codling moths to a wide variety of lamps radiating energy in the visible and ultraviolet regions. Results indicated the most attractive region of the spectrum was between 300nm and 400nm, or near ultraviolet and violet. Madsen and Sandborn (1962) observed that a funnel-type trap with 15 watt BL lamp was very efficient in trapping codling moths.

Glick *et al.* (1956) studied on the attraction of pink bollworm moths and verified the greater response to lamp that radiated in the near ultraviolet (black light) region.

Kelsheimer (1935) observed that European corn borer moths responded in significantly greater numbers to the light of short wavelength (UV) than to those of long wavelength.

Otman and Brook (1961) reported that the BL trap proved to be several times more effective than the regular type incandescent light trap for surveying European corn borer.

Tashiro and Tuttle (1959) experimented with omnidirectional light trap with 4 baffles using 15 watt BL lamps. Trap captured upto 70 times as many beetles as the most attractive chemically baited traps.

Tedders and Osburn (1966) Found that three economically important insects, the hickory Shuckworm (*Laspeyresia caryum*, Fitch) the pecan nut bearer (*Acrobasis nuxvorella,* Nuenzig) and the pecan leaf case bearer (*Acrobasis juglandis, Le* Baron) are highly attracted to BL 15 watt lamps.

All the observations made by various workers in the past on the response of ultraviolet light as discussed above have indicated a strong response of UV light source against variety of insect pest species. There studies are in support of our observations on use of UV light source in light trap.

5.2 Seasonal activity of major insect pest species of Kharif crops collected in light traps operated by MV and UV light sources:

The seasonal variation in the level of pest population in adult stage i.e the seasonal activity of major insect pest, which were trapped regularly every week was studied. In all seven species of major insect pest, Lepidoptera (4), Orthoptera (2), Coleoptera (1) were recorded as regular pest. Observations on their seasonal activity i.e trends in population with major peaks observed have been discussed species wise, in brief below:

1. White grub (*Holotrichia consangunia*)

The pest was active with the onset of monsoon. Activity started in June IV wk at low level. Population reached at its peak in July I wk and declined sharply in July III wk. Population trend in seasonal activity, showed one peak in July I wk in MV as well as in UV light source, while another additional peak was observed in UV light source in July II wk. Population was little higher in UV compared to MV.

In conformity with the present findings, Verma and Vaishampayan (1983) reported that white grub adult activity starts with the onset of monsoon and is limited to rainy season only. Abrupt rise in trap catch was noticed in June IV wk, following pre-monsoon showers.

2. Field cricket (*Gryllus bimaculatus*)

Pest was active throughout the *Kharif* season from June IV wk to October end. Population reached at its peak in July III wk and declined sharply in July IV wk. In MV light source, peak was distinctly higher compared to UV light source. The pest population was considerably low during rest of the period up to October IV wk, Population trend in seasonal activity, showed only one peak appearing in July III wk, in both the light sources i.e MV and UV. Population was distinctly higher in MV compared to UV in this period.

In conformity with the present findings Purthi (1969) as well as Richards and Davies (1980) observed field crickets spp. and their damage many cultivated crops as soil pests damaging roots. The species were collected on light traps in sufficiently high numbers throughout the year. The major active period of *Gryllotalpa* was from August to April with highest activity during October, November and January. The major active period of *Gryllus* spp. was for June to October and again in March, April and May.

On the contrary Rathore (2001) studied that seasonal activity of the pest by light trap and recorded activity during September and October. Highest monthly trap catches were recorded during September.

3. Mole cricket (*Gryllotalpa orienrtalis*)

Pest was active throughout the *Kharif* season from June IV wk to October end. Population reached at its peak in September IV wk in both the light sources. There were four distinct peaks in the population in MV light source appearing in July III wk, September II wk, September IV wk and in October II wk.

In case of UV light source three peaks were observed in August II wk, September I wk and in September IV wk. Population at highest peak in UV light source was however, very low compared to MV light source 96 and 285 mole crickets respectively. Population level was considerably higher in MV compared to UV light source.

In similar to the present findings Rathore (2001) conducted studies on seasonal activity of mole cricket by using the light trap in vegetable farm at Jabalpur (M.P.). Highest monthly catches were recorded during September.

Also similar to the present findings Wang et al. (2012) monitored the activity of mole cricket (*Gryllotalpa* sp.) by using light trap and reported that it had two damaging active period late May to early July and early September to late October.

4. Teak defoliator (*Hyblaea puera*)

It is a serious defoliator pest of teak and active during July and August. Population reached at its peak in July III wk in both the light traps. Population trend in seasonal activity, with one peak in July III wk, was almost similar in both the light sources i.e MV and UV. Another additional peak was observed in UV light only in July IV wk. Pest disappeared onward August IV wk. The overall response was however higher in UV light compared to MV light source.

Similar observations were made by Verma and Vaishampayan (1983) also by operating the trap using MV light source and reported that *Hyblaea puera* was active during July and August only. Peak period of activity was recorded during July and August with two major peaks in the populations suggesting completion of only one generation in this active period.

5. Soybean semilooper (*Plusia chalcites*).

It is a major pest of many *Kharif* pulses including soybean. Pest was active during the Kharif season from August I wk to October end. Population reached at its highest peak in September I wk in MV light source.

Population trend in seasonal activity, showed four peaks appearing in August III wk, September I wk and III wk. Fourth peak was observed at low level in October II wk in both the light sources. Population was considerably higher in MV compared to UV.

Similar observations were made by Verma and Vaishampayan (1983) also by operating the trap using MV light source and reported that *Plusia chalcites* was active throughout the year. The major period was in Kharif from July to November and highest catch was recorded in August.

6. Tobacco caterpillar (*Spodoptera litura*)

Pest was active during the *Kharif* season from July III wk to October end. Population reached at its peak in September II wk in MV and UV. Population trend in seasonal activity, showed three peaks appearing in July IV wk, August IV wk and third highest peak in September II wk in both the light sources i.e MV and UV respectively. Population was considerably higher in MV compared to UV.

Similar observations were made by Verma and Vaishampayan (1983) also by operating the trap using MV light source and reported that tobacco caterpillar was active throughout the year except June. Major active period was July to October with four distinct peaks in population. The highest activity was recorded during September in Kharif season.

7. Bihar hairy caterpillar (*Spilosoma obliqua*)

Pest was active during the *Kharif* season from August I wk to October end. Population reached at its peak in September II wk in MV light source.

Population trend in seasonal activity, showed three peaks in August III wk, September II and October I wk in MV light source. In case of UV light source also three peaks were observed in August I wk. Another two peaks were observed at highest level (almost at same level) in September I and III wk. Population was almost at same level in MV and UV both with the exception of difference in September II wk.

On the contrary Dangi (2004) observed that the peak catch of adults in light trap was observed during the month of December.

Results in brief and recommendation

Our observations showed that Ultraviolet light is a very good light source for its use in light trap for insect pest survey and control compared to mercury vapour light source due to reduced expenditure on electricity i.e MV 160 watt V/S UV 8+8 watt (16 watt). The Ultra Violet light seems to be much cheaper and economic light source. The extensive work done in past 50 years in United States and other parts of the world, as discussed earlier strongly supports our observations on the utility of Ultraviolet light, Specifically UV 15 watt tube (18 inch) as a light source for use in light trap as survey and pest control tool. Ours is a very significant Indian work on the utility of Ultraviolet light source in light trap operation.

Results of our studies in conclusion, supported by work done in the past as discussed above showed that Ultra violet light source i. e. UV 8+8 watt or 16 watt (12’’ tube length) is the best light source for operation of light trap. Best results can be obtained using two UV lamp traps instead trap of one 160 watt Mercury vapor lamp with a consumption of only 16+16 watt (32 watt) i.e almost one fifth compared to 160 watt of one MV lamp. Ultraviolet 8+8 watt (12’’ tube length) and MV 160 watt both the light sources found almost equal in response in majority insect pest species.

Based on (I) Response of insect pest species as discussed above (II) Economy in operation of traps with lowest consumption of low electricity (16 watt) only compared to 160 watt MV lamp and (III) Convenience in operation of traps with solar energy panels, it is recommended to use low watt ultraviolet BL lamp.

SUMMARY, CONCLUSION AND SUGGESTIONS FOR FURTHER WORK

The experiment entitled **"Utility of ultra violet lamp as a light source in light trap compared to mercury vapour against the insect pest in *Kharif* crops"** was conducted at the Breeding Experimental Farm, Adhartal, Jabalpur (MP) during the period between June IV wk to end of October 2017. The objectives were as follows:

3) To study the comparative efficiency of 8+8 watt (16 watt) UV Black light lamp and 160 watt Mercury vapour lamp against major insect pest of *Kharif* crops.

4) To study the seasonal activity of major insect pest species of *Kharif* crops collected in light traps. (MV and UV traps both)

6.1 Summary:

6.1.1. Comparison of UV 8+8 watt (16 watt) and MV 160 watt light source.

Paired t-test was used for testing the significant difference between the treatments MV and UV light source. The mean per day catch per trap (For each week) was computed by dividing total trap catch with number of days of collection obtained in a week. The data so obtained were analyzed by using paired t-test. The response in terms of total mean catch per trap is abstracted in three heads as given below:

1. Higher response in UV compared to MV (Differences non significant):

In *Holotrichia consangunia and Hyblea puera* species numerically (by number of trap catch) Ultra violet lamp has given higher response than MV 160 watt. Statistically, however differences were non significant in the trap catch of these two species.

2. Lower response in UV compared to MV (Differences non significant):

In *Gryllus bimaculatus* and *Spilosoma obliqua* species numerically (by number of trap catch) MV 160 watt has given higher response than UV 8+8 watt, but statistically, differences were non significant in the trap catch of these two species.

3. Lower response in UV compared to MV (Differences significant):

In *Gryllotalpa orientalis, Plusia chalcites* and *Spodoptera litura* species, numerically (by number of trap catch) MV 160 watt has given higher response than UV 8+8 watt. Statistically also their differences were significant at 5% level of significance in all the three species.

6.1.2 Seasonal activity of major insect pest species of Kharif crops collected in light traps operated by MV and UV light sources.

Seasonal changes in the activity of pest species in adult stage monitored by light trap catches (weekly total) operated by MV as well as UV light source have been shown in population graphs of both the light sources. These graphs show the comparative changes in populations with major peaks throughout the active season during the period June IV wk to October end. Species wise observations of the seasonal activity thus studied are given below:

The data of every day catch of major insect pest species of soybean and other *kharif* crop ecosystem collected in trap were converted to weekly total (Corrected to seven days).

2. White grub (*Holotrichia consangunia*)

Activity started in June IV wk at low level. Population trend in seasonal activity, showed one peak in July I wk in MV as well as in UV light source, while another additional peak was observed in UV light source in July II wk. Population was little higher in UV compared to MV.

3. Field cricket (*Gryllus bimaculatus*)

Pest was active throughout the *Kharif* season from June IV wk to October end. In MV light source, peak was distinctly higher than UV light source. Population trend in seasonal activity, showed only one peak appearing in July III wk, in both the light sources i.e MV and UV.

3. Mole cricket (*Gryllotalpa orienrtalis*)

Pest was active throughout the *Kharif* season from June IV wk to October end. There were four distinct peaks in the population in MV light source appearing in July III wk, September II wk, September IV wk and October II wk respectively. In case of UV light source three peaks were observed in August II wk, September I wk and September IV wk respectively. Population level was considerably higher in MV compared to UV light source.

4. Teak defoliator (*Hyblaea puera*)

It is a serious defoliator pest of teak. Pest was active during the *Kharif* season from July I wk to August III wk. Population reached at its peak in July III wk in both the light traps. Population trend in seasonal activity, with one peak in July III wk, was almost similar in both the light sources i.e MV and UV. Another additional peak was observed in UV light only in July IV wk.

5. Soybean semilooper (*Plusia chalcites*).

It is a major pest of many *kharif* pulses including soybean. Pest was active during the *Kharif* season from August I wk to October end. Population trend in seasonal activity, showed four peaks appearing in August III wk, September I wk and III wk respectively in both the light traps. Fourth peak was observed at low level in October II in both the light sources.

6. Tobacco caterpillar (*Spodoptera litura*)

Activity started in July III wk at low level. Population reached at its peak in September II wk in MV and UV. Population trend in seasonal activity, showed three peaks appearing in July IV wk, August IV wk and highest peak in September II wk in both the light sources.

7. Bihar hairy caterpillar (*Spilosoma obliqua*)

Pest was active during the *Kharif* season from August I wk to October end. Population reached at its peak in September II wk in MV light source. Population trend in seasonal activity, showed three peaks in August III wk, September II and October I wk in MV light source. In case of UV light source also three peaks were observed in August I wk and another two peaks were observed at highest level (almost at same level) in September I and III wk.

6. 2 Conclusion:

1. Comparative studies of trap catches revealed that UV 16 watt (8+8) watt has given higher response than MV 160 watt in following species -*Holotrichia consangunia, Hyblaea puera* While, MV has given higher response than UV in following species –*Gryllus bimaculatus, Spilosoma obliqua.*

2. MV has given better response than UV in case of *Gryllotalpa orientalis, Plusia chalcites, Spodoptera litura w*ith significant difference between the catches of MV and UV.

3. Since, all these four species differences in trap catches were statistically non significant shows that trapping efficiency of UV was at par with MV light source. In another words UV light source can be successfully used for operation of light trap as survey and pest control tool.

4. Taking into consideration the total wattage of electricity consumption i.e 160 watt in MV v/s 16 watt in UV, the UV 16 watt (8+8 watt) seems to a much cheaper & economic light source than MV. Besides the economy, the trapping efficiency of UV light source is also at par with MV in majority of the species as stated above. In view of these observations, UV light source (16 watt) seems to be very good alternative source to MV 160 watt for operation of light traps for monitoring activity and pest control device. Seasonal activity trends in population graphs in all the species in UV light were quite comparable with MV light source.

5. Seasonal activity of 7 species of insect pest, which were observed in trap catches operated in field (Kharif crop) regularly in considerable numbers were studied in *Kharif* season during the period June to October end (2017). Two to three peaks were observed in general, showing period of highest & lowest activity both.

6.3. Suggestions for further work:

Since ultra violet light has given very good results following studies have been suggested for future work.

1. Comparison of performance of light trap operated by UV 8+8 v/s single 10 watt UV lamp.
2. Comparison of operation of two traps (10 watt each) per hectare v/s one trap operated by 125 watt MV lamp
3. Comparison of UV 8+8 watt (Pair) BL v/s BLB UV lamps.
4. Study effect on incidence of pest population (as a control method) in trap area compared with non-trap area (one trap per acre crop area)

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