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Comparative efficiency of 125 watt Mercury lamp and 15 watt UV (Black light) tube against the major insect-pest in paddy ecosystem

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Abstract
This study examined the comparison between 125 watt mercury lamp and 15 watt UV tube used in light trap in the paddy ecosystem at Jabalpur (M.P) during *kharif* season 2017. Comparative studies of trap catches revealed that Ultraviolet 15 watt has given a higher response than MV 125 watt in following species - *Nephotettix virescens*, *Leptocorisa acuta*, *Cnaphalocrocis medinalis* and *Mythimina separata* While, Mercury vapour has given a higher response than Ultraviolet in following species – *Parapoynx stagnalis* and *Melanitis leda ismene*. In other words Ultraviolet light source can be successfully used for the operation of light trap as survey and pest control tool. Taking into consideration the total wattage of electricity consumption in 125 watt MV v/s 15 watt UV, the Ultraviolet 15 watt seems to a much cheaper & economic light source than MV. Besides the economy, the trapping efficiency of Ultraviolet light source is also at par with MV in majority of the species as stated above. In view of these observations, Ultraviolet light source (15 watt) seems to be a very good alternative source to MV 125 watt for operation of light traps for monitoring activity and pest control device.

Keywords: Mercury vapour, ultraviolet, insect pest, *kharif*, paddy eco-system

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) [6]. Vaishampayan (2002) [5] proposed a new concept of adult-oriented pest management strategy, which is based on the suppression of pest population through mass trapping and killing of adults using their behavioral responses (visual, olfactory, gustatory, sexual reproductive, biological, etc.) and described the salient points of using light traps as a component of such strategy. Now the use of light trap has become a common tool for various studies in entomological research. Garris and Snyder (2010) [2] reported that phototactic behavior toward ultraviolet light varies among nocturnal flying insects. Light trap has been used to supplement the knowledge of the pest fauna of a given locality, geographical distribution and their seasonal activity etc. (Verma and Vaishampayan, (1983) [7]. 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.

Materials and Methods
The experiments were conducted on the Krishi Nagar experimental farm, Adhartal, JNKVV Jabalpur (MP) during the period between the first week of July to last week of October, (2017 -2018). The experiment was conducted by using SMV-4 light trap model with Ultraviolet light 15 watt tubes and Mercury vapour 125 watt was used as light source. Comparison of

Ultraviolet Black light lamp and Mercury vapour lamp against major insect pest in the paddy eco-system was based on catches obtained on a daily basis by operating the light trap throughout the kharif season and were converted into standard weekly averages. 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 the major species and order groups. Data of the daily trap catch was maintained.

In all, two light traps were installed in the experimental area. This area was covered mainly by a paddy crop. Spacing between each trap was approximately 100 meter. 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 the instant killing of trapped insects. Insects were collected from the collection bag every morning.

Comparative efficacy of two light sources

It includes two treatments to compare the relative efficiency of an Ultraviolet lamp over mercury vapour lamp as light source in a light trap in trapping and collecting insects of various crop pest species. The data so obtained was analyzed by using a paired t-test.

T1 - MV (Mercury Vapor) lamp 125 watt

T2 - UV (Ultra Violet) tube 15 watt

Results

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

Comparative efficiency of ultraviolet and Mercury vapour light sources based on response of six insect pest species namely Green leaf hopper *Nephotettix virescens*, Gundhi bug *Leptocorisa acuta*, Leaf folder *Cnaphalocrocis medinalis*, Rice caseworm *Parapoynx stagnalis*, Rice Armyworm *Mythimina separate*, Rice butterfly *Melanitis leda ismene* were identified as important positively phototropic insect pests in paddy crops because they occoured regularly and significantly high number in trap catches. Name of major species observed in trap catches and Species wise description is given in Table No.1 and the of comparative responses of the insect pests towards the light sources is described in detail in Table No. 2.

Table 1: Name of major species observed in trap catches

Sr. No	Common Name	Scientific Name	Order	Family
1	Green leafhopper	*Nephotettix virescens*	Homoptera	Cicadellidae
2	Gundhi bug	*Leptocorisa acuta*	Homoptera	Coreidae
3	Leaf folder	*Cnaphalocrocis medinalis*	Lepidoptera	Pyralidae
4	Rice caseworm	*Parapoynx stagnalis*	Lepidoptera	Crambidae
5	Rice Armyworm	.*Mythimina separata*	Lepidoptera	Noctuidae
6	Rice butterfly	*Melanitis leda ismene*	Lepidoptera	Nymphalidae

Table 2: Comparative response of insect pest species towards light sources (T1- MV 125 watt, T2- UV 15 watt)

S.no.	Observation period weekly	Species wise mean per day catch per trap											
		N. virescens		*L. acuta*		*C. medinalis*		*P. stagnalis*		*M. separate*		*M. leda ismene*	
		T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2
1	July I wk	0	0	0	0	0	0	0	0	0	0	0	0
2	July II wk	0	0	0	0	0	0	0	0	0	0	0	0
3	July III wk	0	0	0	0	0	0	0	0	0	0	0	0
4	July IV wk	0	0	0	0	0	0	0	0	0	0	0	0
5	Aug I wk	0.00	0.00	0	0	0	0	0	0	0	0	0	0
6	Aug II wk	21.16	16.16	0	0	0	0	0	0	0	0	0	0
7	Aug III wk	37.66	24.50	0	0	0	0	0	0	0	0	0	0
8	Aug IV wk	50.71	32.14	1.42	1.42	0	0	0	0	0	0	0	0
9	Sept I wk	39.17	144.67	5.83	85	5.5	3.83	0	0	0	0	1.2	1.3
10	Sept II wk	132.88	95.50	11.75	20.88	5.87	7.37	0	0	3.12	4.13	1.2	1
11	Sept III wk	153.83	141.66	16.5	18.66	4.83	7.16	2.66	1.5	4.16	2.83	1.33	1
12	Sept IV wk	206.75	164.12	28.62	31.37	7.5	6	3	2.13	2.13	5.87	1.66	1.14
13	Oct I wk	314.43	353.29	21.43	30	14.29	14.86	10.58	8	4.42	6	1.5	1.33
14	Oct II wk	243.12	287.25	17.12	23.13	5.25	8.63	10.13	5.75	4.75	4.37	1.33	1.83
15	Oct III wk	165.72	176.15	22.58	19.71	4.43	4.43	3.14	3.14	5.14	3	1.42	1
16	Oct IV wk	95.00	86.66	70.44	6.11	3.67	3.44	3.33	2.56	3.67	2.33	0	0

1. Green leaf hopper (*Nephpotettix virescens*)

Details of statistics with light sources MV and UV	T1 MV125W	T2 UV15W
Mean	132.77	138.37
Variance	9060.38	11419.50
No. of observation	11	11
Degree of Freedom	10	
t_{cal}	0.434 NS	
t_{tab}	2.228	

- The calculated value of t (0.434) is found to be less than the tabulated value of t at 10 Degree of Freedom at (5%)

level of significance (2.228). Hence, we accept the null hypothesis and conclude that there is no significant difference between the mean of MV 125 Watt and UV 15 Watt.

- Numerically trap catch was higher in UV than MV.

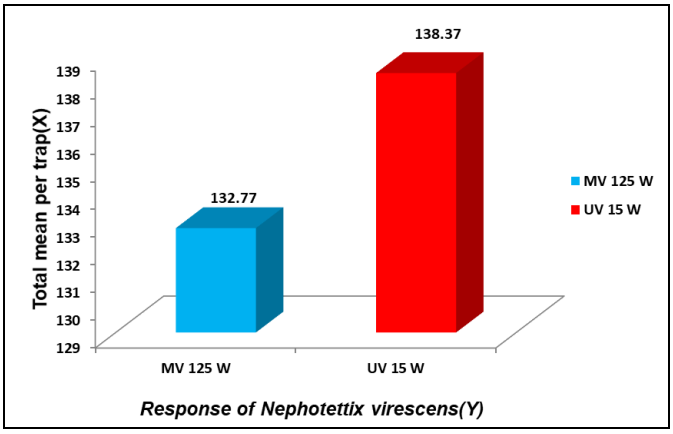

Fig 1: Response of Green leaf hopper (*Nephpotettix virescens*)

2. Gandhi bug (*Leptocorisa acuta*)

Details of statistics with light sources MV and UV	T1 MV125W	T2 UV15W
Mean	21.74	26.25
Variance	404.31	581.62
No. of observation	9	9
Degree of Freedom	8	
t_{cal}	0.38 NS	
t_{tab}	2.306	

- The calculated value of t (0.38) is found to be less than the tabulated value of t at 9 Degree of Freedom at (5%) level of significance (2.306). Hence, we accept the null hypothesis and conclude that there is no significant difference between the mean of MV 125 Watt and UV 15 Watt.
- Numerically trap catch was higher in UV than MV.

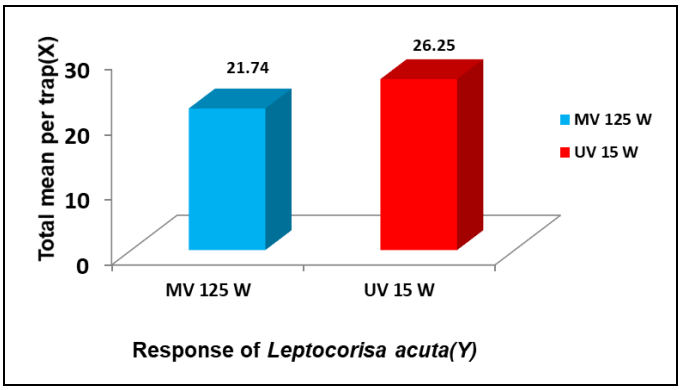

Fig 2: Response of Gundhi bug (*Leptocorisa acuta*)

3. Leaf folder (*Cnaphalocrocis medinalis*)

Details of statistics with light sources MV and UV	T1 MV125W	T2 UV15W
Mean	6.42	6.97
Variance	11.38	13.56
No.of observation	8	8
Degree of Freedom	7	
t_{cal}	0.871 NS	
t_{tab}	2.365	

- The calculated value of t (0.871) is found to be less than the tabulated value of t at 7 Degree of Freedom at (5%) level of significance (2.365). Hence, we accept the null hypothesis and conclude that there is no significant difference between the mean of MV 125 Watt and UV 15 Watt.
- Numerically trap catch was highest in UV than MV

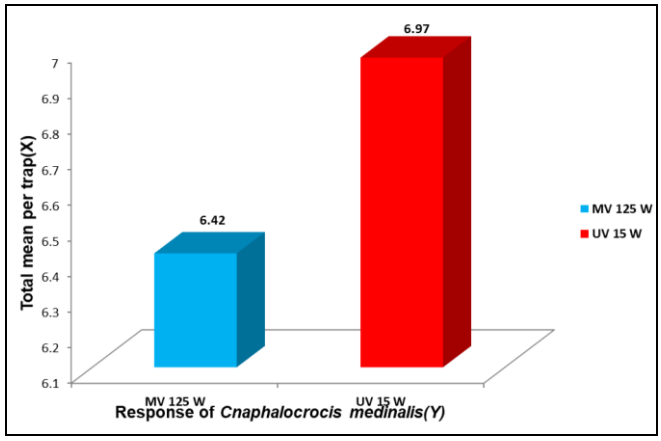

Fig 3: Response of Leaf folder (*Cnaphalocrocis medinalis*)

4. Rice caseworm (*Parapoynx stagnalis*)

Details of statistics with light sources MV and UV	T1 MV125W	T2 UV15W
Mean	5.47	3.85
Variance	14.37	6.30
No.of observation	6	6
Degree of Freedom	5	
t_{cal}	2.504 NS	
t_{tab}	2.571	

- The calculated value of t (2.504) is found to be less than the tabulated value of t at 5 Degree of Freedom at (5%) level of significance (2.571). Hence, we accept the null hypothesis and conclude that there is no significant difference between the mean of MV 125 Watt and UV 15 Watt.
- Numerically trap catch was higher in MV than UV.

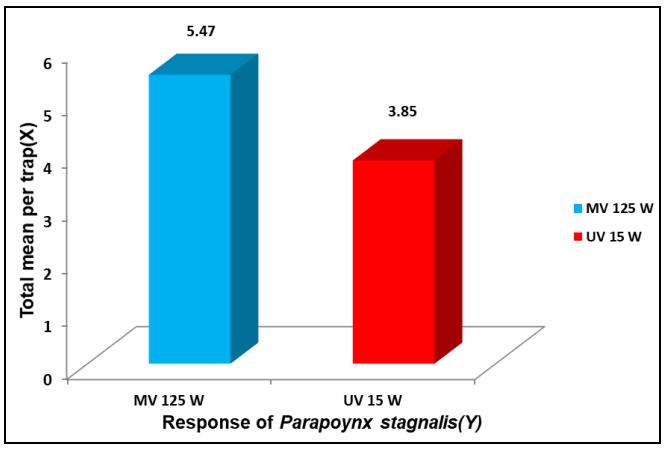

Fig 4: Response of Rice caseworm (*Parapoynx stagnalis*)

5. Armyworm (*Mythimina separata*)

Details of statistics with light sources MV and UV	T1 MV125W	T2 UV15W
Mean	3.89	4.08
Variance	1.02	2.13
No.of observation	7	7
Degree of Freedom	6	
t_{cal}	0.242 NS	
t_{tab}	2.447	

- The calculated value of t (0.242) is found to be less than the tabulated value of t at 6 Degree of Freedom at (5%) level of significance (2.447). Hence, we accept the null hypothesis and conclude that there is no significant difference between the mean of MV 125 Watt and UV 15 Watt.
- Numerically trap catch was higher in UV than MV

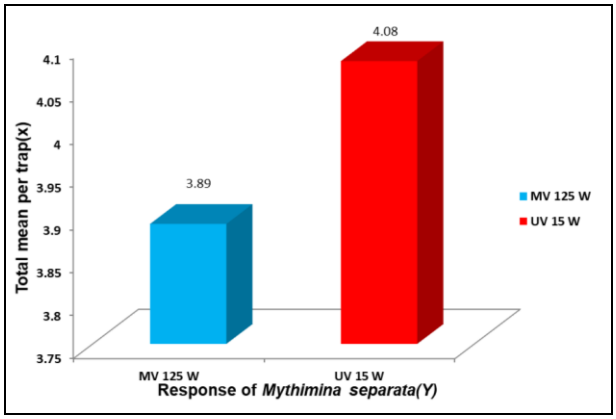

Fig 5: Response of Armyworm (*Mythimina separata*)

6. Rice butterfly (*Melantis leda ismene*)

Details of statistics with light sources MV and UV	T1 MV125W	T2 UV15W
Mean	1.38	1.23
Variance	0.027	0.090
No.of observation	7	7
Degree of Freedom	6	
t_{cal}	1.127 NS	
t_{tab}	2.447	

- The calculated value of t (1.127) is found to be less than the tabulated value of t at 6 Degree of Freedom at (5%) level of significance (2.447). Hence, we accept the null hypothesis and conclude that there is no significant difference between the mean of MV 125 Watt and UV 15 Watt.
- Numerically trap catch was higher in MV than UV.

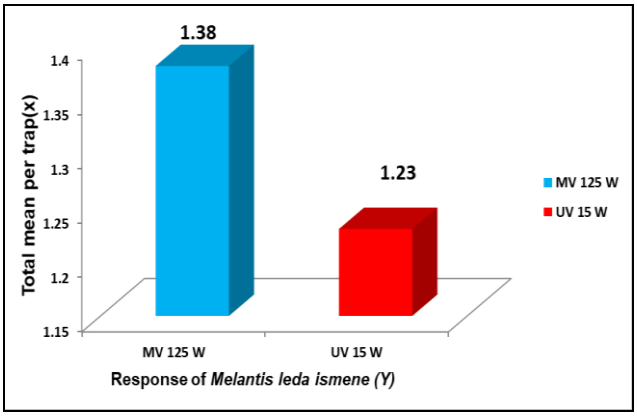

Fig 6: Response of Rice butterfly (*Melantis leda ismene*)

Discussion

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

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

The species show higher response in UV is listed below:

1. Green leaf hopper, *Nephotettix virescens* (Hemiptera)
2. Gundhi bug, *Leptocorisa acuta* (Hemiptera)
3. Leaf folder, *Cnaphalocrocis medinalis* (Lepidoptera)
4. Rice Armyworm *Mythimina separata* (Lepidoptera)
5. In above four species numerically (by number of trap catch) UV 15 watt has given higher response i.e better than MV 125 watt, but statistically, differences were non-significant in the trap catch of these four species.

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

The species show higher response in UV is listed below:

1. Rice Caseworm, *Parapoynx stagnalis* (Lepidoptera)
2. Rice butterfly, *Melanitis leda ismene* (Lepidoptera)

In above two species numerically (by number of trap catch) UV 15 watt has given lower response i.e better than MV 125 watt, but statistically, differences were non-significant in the trap catch of these two species.

Therefore, taking into consideration the relative response, lower wattage consumption, trap catches etc UV 15 watt light source seem to be much cheaper and economic light source and a very good substitute to MV 125 watt as a pest control, survey and monitoring device.

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) [7] 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.

Taylor and Deay (1950) [4] 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) [1] Concluded that the radiation outputs between 320 and 400nm were more attractive to moths of the tomato and tobacco hornworm species. Menear (1961) [3] found good response of hornworms were nearly as good throughout the Ultraviolet region.

Conclusion

Overall results of experiments conducted in two sets have shown that UV Black light lamp (15 watt) when used in light trap have given a very good response in terms of light trap catches, compared to MV lamp. The trap catches were obtained in UV light source operated light trap are more than 60 % of the trap catches of MV operated light trap. In some cases the trap catches obtained in UV are about 90 % of the trap catches obtained in MV operated light trap. Finally it is concluded that the use 15 watt UV lamp (BL) instead of 125 watt Mercury vapour lamp for its use in light trap as survey and pest control tool. Because the response of insect pest species and economy in operation of traps with the lowest consumption of low electricity (15 watt) only compared to 125 watt MV lamp.

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