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Influence of the different light sources in egg laying behavior of *Helicoverpa armigera* (Hubner) (Lepidoptera: Nuctuidae) of moths in ascending and descending phase of lunar cycle

Vivek Singh Tomar, Rajesh Verma, US Mishra and Ashutosh Sarker

Abstract
Helicoverpa armigera is a major pest of chickpea. Ovipositional behavior of moth is govern by the biological clock of the moth regulated the ovipositional rhythm in subsequential lunar cycle. Presence or absence of artificial light influenced the intensity of egg laying to the same extent but not the pattern of egg laying in different quarters of the lunar cycle. Egg laying behavior of *H. armigera* in chickpea studies in 5 lunar cycles. Data revealed that ascending phase 39% in white transparent cage 33% and 28% in dark cage. In descending phase 35 % white artificial cage, 34% dark cage and 31% white transparent cage.

Keywords: *Helicoverpa armigera*, lunar cycle, behavior

Introduction
Helicoverpa armigera is strong photopositive nocturnal insect and very important insect-pest of chickpea crops in India. The moon illumination during night hours weather it is artificial or nouctrunal influences the normal behavior of insects. Scotophase and photophase period during night hours alter the behavior of night flying insects. Moon is the natural scotopic illumination present during night hours. Cyclic changes in moon disc illumination influences the intensity of moon light that further influences the activity of night flying insects. Lunar cycle has two phases (ascending and descending) consisting quarters, i.e., waxing crescent (0-50% disc illumination) waxing gibbous (100-50%), waning gibbous (100-50%) and waning crescent (50-0%) (Courter 2003) in present paper egg laying behaviour of moth studied in different quarters of moon phase and also in presence of and also in presence of artificial light under field condition.

Material and methods
To study the egg laying behavior under field condition, the field cages of size 1.0 m x 1.0 m x 1.0 m were specially prepared for fixing in chickpea field. Three types of cages were used; One dark control cage (cage A) which was covered with black cloth and other net cage white trans parent (cage B) was covered with light white nylon net in order to allow maximum penetration of artificial and moon light inside the cage. Third white artificial cage (cage c) was expressed to artificial light condition throughout the lunar cycle. LED 15 watt lamp was used as artificial light. Moths of *Helicoverpa armigera* was collected carefully every morning from light trap equipment with 125 watt mercury vapour lamp and placed in a handy field cage in a cool area. Socked cotton in ten per cent sugar solution was hanged in a cage for feeding. In the evening the counted numbers of female moths were released in cages before down, fixed in a chickpea field side by side. Next morning the moths were removed and the eggs laid on gram plants were counted carefully. Repeated daily up to 5 lunar cycle.

Result and Discussion
Egg laying data of white transparent (B), white artificial (C) and dark cage(A) indicated that in ascending phase the per cent of egg laying is higher (39%) in white transparent cage followed by white artificial cage light (33%) and the lowest per cent of egg laying (28%) in dark cage (Fig 1).

In descending phase the egg laying per cent is higher (35%) in white artificial cage followed by the dark cage (34%) and lowest in white transparent cage (31%) Fig 2. Data further indicated that the entrainment behavior of egg laying rhythm in moths mostly remain unchanged Irrespective of the condition of scotophase and photophase during night hours. In ascending phase the mean number of egg laying are higher than the descending phase i.e. 41.96, 31.24 and 30.75 in white transparent, white artificial and dark cage. Egg laying intensity of moths is reduced per cent if artificial light present during night hours as observed in eggs laid in white transparent cage and white artificial cage (C) (33-39= -6%) in ascending phased the reduction was is - 6%. Under total darkness (cage A) the egg laying is reduced to -11 per cent (28-39=-11) and there is increase in egg laying by 5 % (33-28= 5%) observed over dark situation, when moths are expressed to artificial light situation (33-28=5%) and 11% under natural light situation.

Malik and Seth, 2017, Goto, 2013 observed insect behaviors' are influenced by circadian system and functional involvement of circadian clock and photoperiodism on the activity of insect. This is in support of our finding as artificial situation affect the normal circadian clock for egg laying was fixed based on the changing environmental situation faced by the *H. armigera* moth from its phylogenic development period, this was disturb when the moth are exposed to total light hour, total dark situation during the night hours.

Table 1: Mean per cent of egg laying in cages during lunar cycle

Cages	Ascending phase	Waxing crescent	Waxing gibbous	Descending phase	Waning gibbous	Waning gibbous
Dark Cage (A)	28 (-11)	24(21)	32 (2)	34 (+3)	33 (0)	35 (+7)
White transparent (B)	39	45	34	31	33	28
White artificial (C)	33 (-6)	31 (14)	34 (0)	35 (+4)	34 (+1)	37 (+9)
Note: Increase and decrease in egg laying over white transparent cage (B) in cage A and C						

In ascending phase of lunar cycle moon light was always present during the early part of night while in descending phase no moon situation occurred in early part of night. Egg laying behavior when studied in ascending and descending phases including waxing and waning, crescent/gibbous shows that there is decrease in egg laying observed by -6 and -11%,-14 and -21% and 0 and - 2% in ascending phase (waxing crescent and waxing gibbous) while the +4 and +3%, +1 and 0.0% and +9 and +7 per cent in descending phase waning crescent and waning gibbous respectively. In white transparent cage over the white artificial and dark cage respectively. The probable cause of this changing behavior of moth is due to the moon lit and moon light less situation coincides with the time of egg laying of the moth. Indicated that the differential response on the circadian rhythm of egg laying in different situation /time/moon/cycle by total presence of light and total darkness condition during the night hours. Differential olfactory response in antennae of Cockroach *Leucophaea maderae*, was reported by Page and Koelling, 2003. Exhibits robust light entrained circadian rhythm its sensitivity changes in different condition. As observed in case of *H.armigera* circadian rhythm of egg laying changes in different phases of lunar cycle.

Behavioral changes of moth in waxing crescent (0-50% disc illumination) of ascending of cycle in waning crescent (50-0%) of descending cycle characterized by the increase and decreasing hours of scotophase in early part of the night under such condition the normal ovipositional behavior of moth was different. This hypothesis reflected by the number of egg laid by the moth in dark cage, white transparent cage and white artificial cage. The percentage of egg laid nearly similar that is were 45%, 31%, 24% and 33%, 33%, 34% (Fig.3 and 4) respectively. In waxing gibbous (50-100) of ascending phase and waning gibbous (100-50) of descending phase characterized by presence of moon light in early quarters of the night and (waxing gibbous) absence of moon light in early quarters of the night (waning gibbous) behavior of egg laying of moths are (34, 34 and 32%) higher in waxing gibbous as compared to waning gibbous in Fig.5 (28, 37 and 35%) in white transparent cage, white artificial cage, dark cage in Fig.6 respectively.

Thus concluded that the ovipositional behavior of moth is govern by the biological clock of the moth regulated the ovipositional rhythm in subsequential lunar cycle. Presence or absence of artificial light may influenced the intensity of egg laying to the same extent but not the pattern of egg laying in different quarters of the lunar cycle. Verma, *el al.*, 2017 [9] reported that scotophase enhance the egg laying in moths when it coincides in early hours of higher in first half quarters of first quarters in ascending phase, the moon light was dim and insufficient to reset the phase of circadian clocks.

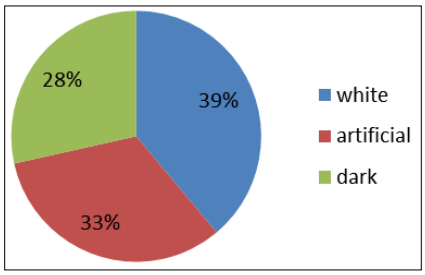

Fig 1: Egg laying in diiferent cages of ascending phase.

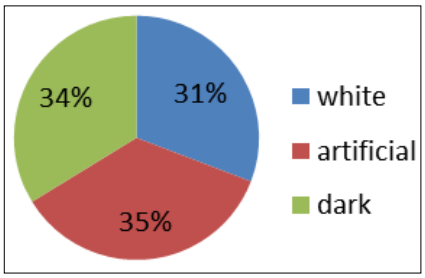

Fig 2: Egg laying in diiferent cages of descending phase

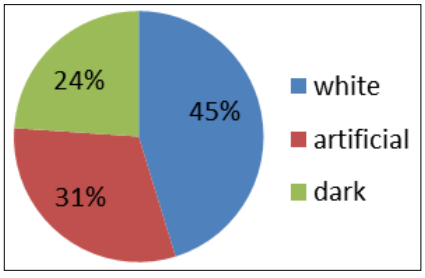

Fig 3: Egg laying in diiferent cages of waxing cresent

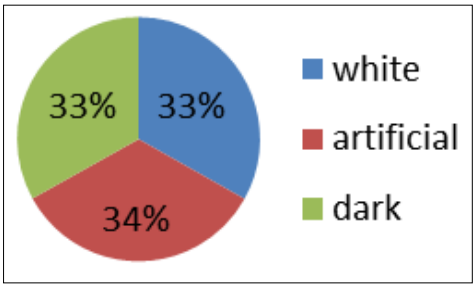

Fig 4: Egg laying in diiferent cages of wanning cresent

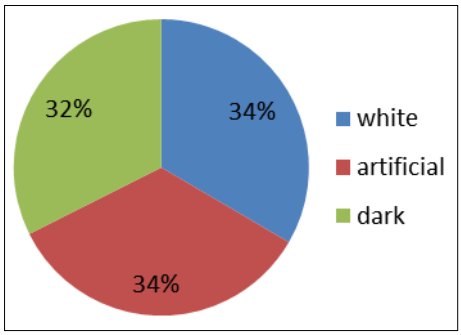

Fig 5: Egg laying in diiferent cages of waxing gibbous

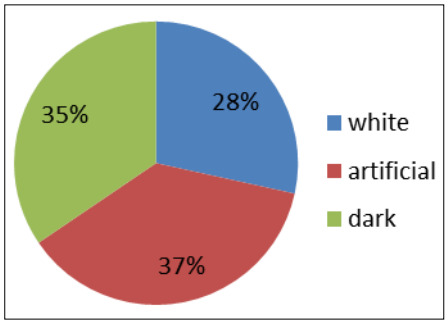

Fig 6: Egg laying in diiferent cages of wanning gibbous

Scotophase/photophase situation coincides with maximum egg laying period of the moth. Our finding sported by Rojas, *et al.*, 2001 [7] observed in descending phase of lunar cycle as scotophase present in early hours of night. Coincides with maximum oviposion in case of *Mamestra brasica* (Lepidoptera: Nuctudade) Gayakwad, 2010 [3] observed the moonlight suppress the egg laying while scotophase enhances however present finding are in contradiction with fact that the mean egg laying was higher (8.0%) in ascending phase as compared to descending phase.

Conclusion

Influence of artificial light during night hours along with moon light and its influence on egg laying pattern of moth, results suggested that the entrainment behavior of egg laying rhythm remained largely unchanged irrespective to presence or absence of artificial or natural light. Behavioral change in egg laying of moth also observed in ascending phase including waxing crescent/gibbous there were increase and decrease in egg laying observed leads to the conclusion that the ovipositional behavior of moth regulated by the biological clock in rhythmic way regulated by the lunar cycle.

References

1. Byers JA. Novel fraction collector for studying the oviposition rhythm in the turnip moth. Chronobiology International. 1978; 4:189-194.
2. Courter DC. Predicting Moonlight Brightness for Night Landscape Photography. Lunar Light Photography, 2003. http://members.trainorders.com/ cimascrambler/web_page/M onlight_Brightness5a.htm.
3. Gayakwad S. Natural scotopic illumination and its role in entrainment of egg laying rhythm of *Helicoverpa armigera* Hubner (Lepidoptera: Noctuidae); MSc. Thesis, RVSKVV, Gwalior, India, 2010.
4. Goto Shin G. Roles of circadian clock genes in insect photoperiodism entomological Science. 2013; 16:1-16.
5. Malik K, Kumar R. Insect clocks implication in an effective pest management. Biologiacl Rhythm Research, 2017, 48-5
6. Page, Koelling. Circadian rhythm in olfactory response in the antennae controlled by the optic lobe in the cockroach. Journal of Insect Physiology. 2003; 49:697-707.
7. Rojas JC, Wyatt TD, Birch MC. Oviposition by *Mamestra brassica* (L.) (Lepidoptera: Noctuidae) in relation to age time of day and host plants. Journal of Applied Entomology. 2001; 125(3):161-163.
8. Vaishampayan SM, Verma R. Influence of moon light and lunar periodicity on the light trapcatches of gram pod borer, *Helioths armigera* (Hubn.) moths. Indian J Ent. 1982; 44(3):206-212.
9. Verma R, Singh S, Gaykwad S. Influence of lunar periodicity on the egg laying behavior of *Helicoverpa armigera* Hubner (Lepidoptera: noctuidae). Journal of Environmental Science, Toxicology and Food Technology. 2017; 11(10):84-86.