International
Journal of Agriculture Innovations
and Cutting-Edge Research

Monitoring of Pink Bollworm (Pectinophora Gossypiella) Through Light Trap in Cotton Crop at Tando Allahyar & Matiari District

Zahid Usman Shar[1], Noor Nabi Bhutto[2], Bhai Khan Solangi[3], Shafique Ahmed Memon[4] (Corresponding Author), Khalil Ahmed Memon[5],

[1] Scientific Officer, Agriculture Research center Tando Jam, zahidusman67@gmail.com,
[2], Project Coordinator, World wide Fund for Nature (WWF) Pakistan, bhuttonoornabi@gmail.com
[3], Professor, Dept. of Entomology, Sindh Agriculture University, Tandojam, Pakistan. bksolangi@sau.edu.pk
[4], Associate Professor, Dept. of Entomology, Sindh Agriculture University, Tandojam, Pakistan. ahmedshafique89@yahoo.com
5 Premium Organic Cotton Project, Pacca chang, Sindh, Pakistan, khaleelmemon27@gmail.com

Abstract

The study was conducted in two districts, Tando Allahyar and Matiari, to monitor the pink bollworm (Pectinophora gossypiella) using the light trap technique on cotton crops at the experimental fields of Taluka Jhando Marri, District Tando Allahyar, Sindh. The study was carried out for three months. During the observation period, the pest was monitored through light traps, and results showed that only the Pectinophora gossypiella species was found. The results further revealed the relationship of the pest with different stages of the crop, such as vegetative, flowering, and fruiting stages. In District Tando Allahyar, a greater number of adult moths were captured, particularly during the flowering and fruiting stages of the cotton crop. The catches were recorded as: first fortnight of June (18.62), second fortnight of June (19.50), first fortnight of July (12.50), second fortnight of July (12.37), first fortnight of August (11.37), and second fortnight of August (10.25). The average maximum and minimum temperatures (48˚C and 36˚C) recorded during 2019 at Taluka Jhando Marri indicated that temperature changes affected the prevailing percentage of insects. The pink bollworm showed consistent activity throughout June, with a noticeable peak during mid-month. Similarly, the study conducted at the experimental field of Taluka Hala, District Matiari, showed that adult moths captured through light traps were: first fortnight of June (18.50), second fortnight of June (18.00), first fortnight of July (16.62), second fortnight of July (16.12), first fortnight of August (13.37), and second fortnight of August (12.37). The average maximum and minimum temperatures (48˚C and 30˚C) recorded during 2019 at Taluka Hala indicated that temperature variation affected the pest's prevalence.

Keywords: Pink Bollworm; Light Trap; Cotton; Temperature; Monitor

DOI:	https://zenodo.org/records/17584232
Journal Link:	https://jai.bwo-researches.com/index.php/jwr/index
Paper Link:	https://jai.bwo-researches.com/index.php/jwr/article/view/174
Publication Process	Received: 27 Jal 2025/ Revised: 26 Sep 2025/ Accepted: 28 Sep 2025/ Published: 10 Oct 2025
ISSN:	Online [3007-0929], Print [3007-0910]

| *Indexing:* | Academia.edu, DRJI, doi, zenodo, Google Scholar, INDEX COPERNICUS INTERNATIONAL |
| *Publisher:* | BWO Research International (15162394 Canada Inc.) https://www.bwo-researches.com |

Introduction

Pakistan is an agro-based economy where agriculture contributes approximately 18.5% to the country's Gross Domestic Product (GDP), and employs about 38.5% of the national labour force. In terms of agricultural value addition, cotton holds a position of immense importance, being the second most valuable cash crop of Pakistan, contributing 4.5% to the agricultural GDP and 0.8% to the National GDP. Moreover, cotton serves as a vital source of foreign exchange earnings, underpinning the growth of Pakistan's textile industry. Since both the agricultural and textile sectors depend heavily on cotton, enhancing its productivity remains a matter of national importance. Low cotton yields not only affect growers and traders but also influence textile prices and export competitiveness (Source: https://gallup.com.pk/intern-publication-3-cotton-production-in-pakistan/). Pakistan's agrarian economy relies extensively on cotton production, which serves both as a source of rural income and a major contributor to foreign exchange, accounting for nearly 60% of total export earnings. Therefore, efforts are urgently required to increase per-hectare yield through the adoption of modern production technologies. However, the cotton crop remains highly susceptible to insect pest infestations throughout its growing period from the seedling to the picking stage. Among the key insect pests, bollworms are the most destructive, feeding on buds and bolls in all cotton-growing regions (Attique, 1992). Previous studies have reported significant yield losses caused by bollworms, ranging from 30% to 40% (Ahmad, 1980). The potential yield reduction due to insect infestations overall is estimated at 21% (Ali et al., 1982), while specific losses from bollworm attacks have been documented between 6% and 38% (Bishara and Shakeel, 1982). Among these pests, the pink bollworm (Pectinophora gossypiella) has been identified as a major pest of cotton, causing severe damage to fruiting parts and deteriorating the quality of seed cotton. Once the eggs hatch and larvae bore into the bolls, chemical control becomes highly ineffective (Chamberlain et al., 1994). Globally, Pectinophora gossypiella has achieved major pest status, becoming one of the most economically devastating pests of cotton (Ghosh, 2001). It has been reported to cause 2.8–61.9% loss in seed cotton yield, 2.1–47.10% reduction in oil content, and 10.70–59.20% loss in normal boll opening (Patil, 2003). Various insect sampling methods have been developed to study pest populations and their seasonal dynamics. Ground-dwelling insects such as Formicidae (ants) and certain Coleoptera (beetles) are commonly sampled through pitfall traps, while low-flying diurnal insects are collected using Malaise traps, and more robust species through sweep nets (Malaise, 1937; Marinoni and Dutra, 1997; Mason and Bordera, 2008; Aguiar and Santos, 2010). However, many insect species are nocturnal and thus remain inaccessible to these conventional methods. Such species are more efficiently captured through light-trapping techniques (Szentkiralyi, 2002). Light trapping has become one of the most common and reliable methods for sampling nocturnal insects and for studying their abundance, diversity, and seasonal flight activity (Szentkiralyi, 2002). Certain species are particularly sensitive to light and can be caught at specific times during the night (Kitching and Cadiou, 2000). Automated light traps, which are self-operating, offer quantitative data on nocturnal insect abundance (Szentkiralyi, 2002). Although light traps may be relatively expensive, they are remarkably efficient in insect collection (Basset et al., 1997; Liu et al., 2007). Insects such as moths navigate using lunar light, maintaining a constant angle to light rays for straight-line flight. When confronted by a closer and brighter light source, they tend to spiral inward and ultimately collide with it (McGavin, 2007). The development of light sources that emit high-intensity UV radiation has greatly enhanced the effectiveness of light traps (McGavin, 2007). Many nocturnal arthropods, particularly insects, are strongly attracted to such artificial light sources (Nag and Nath, 1991; Axmacher and Fiedler, 2004). Light traps employing mercury vapour lamps, gas lamps, or fluorescent UV tubes have therefore been widely used for nocturnal insect sampling (Brehm and Axmacher, 2006). These light-based devices attract insects, which then fall into the collecting chamber, allowing researchers to obtain valuable data on insect distribution, abundance, and seasonal flight patterns (Walkden and Whelan, 1942). Among the various light sources tested, UV and mercury lights capture more insects than incandescent lamps, making them particularly efficient for collecting moths, beetles, bugs, flies, and other active nocturnal insects (Lindquist et al., 1983; Borror, 1981). With minimal human effort, light trapping can yield a large number of specimens (Holloway et al., 2001; Fiedler and Schulze, 2004), a fact especially true for automatic light traps that require no continuous observation (Southwood and Henderson, 2000). Despite extensive global literature on the use of light traps and the behaviour of Pectinophora gossypiella, localized data from Sindh Province, particularly the districts of Tando Allahyar and Matiari, remain scarce. Given the distinct agro-climatic conditions of these districts, such information is essential for devising targeted pest management strategies. Therefore, the present study was undertaken to monitor the activity pattern of pink bollworm using light traps in these two cotton-growing districts and to analyze its relationship with temperature and crop growth stages under local environmental conditions.

Materials and Methods

The present study was conducted at the experimental area of CABI's Better Cotton Project–Sindh, located in the Tando Allahyar and Matiari districts during the 2019 cotton-growing season. The experiment aimed to monitor adult pink bollworm (Pectinophora gossypiella) populations using light traps. The selected research field covered an area of approximately 2 acres in each district. Observations were made daily, and data were pooled for subsequent analysis. The monitoring period extended from 1st June to 31st August 2019. Moth catches were recorded at fortnightly intervals, after which the captured moths were removed from the traps. Simultaneously, maximum and minimum temperatures were recorded to study their correlation with moth activity.

Installation of Light Traps

A total of sixteen (16) light traps were installed at the center of each cotton field (2 acres) to capture adult pink bollworm moths. Each trap was mounted approximately 1 foot above the crop canopy and operated for two hours during the night. The light source used was a solar-powered LED torch with a white-light emission spectrum, producing approximately 250–300 lumens with an effective wavelength range of 400–700 nm. This light source was chosen for its energy efficiency and continuous illumination capability throughout the trapping period. Each light trap was a funnel-type design, consisting of a light-emitting unit mounted above a transparent conical funnel leading into a collection chamber. The attracted moths, upon approaching the light source, were guided downwards through the funnel into the collecting container, where they were unable to escape. The traps were fabricated using locally available materials following standard entomological trap design principles (similar to Szentkiralyi, 2002). Captured insects were collected each morning, identified to species level under laboratory conditions, and counted. The data obtained were analyzed to assess the relationship between moth abundance, temperature variation, and crop growth stages during the observation period.

Data collection

The data was collected at 15-day intervals

Results and Discussions

Tando Allahyar

The present study revealed that the population of Pink Bollworm varied with the month of the year. It is evident from the results that, except for June, pink bollworm remained active throughout the month of June. The population in June could be attributed to the climatic conditions and the temperature reached at 48˚C during June, and in July, 46˚C and August, max 42˚C or maybe due to the emergence of moths from the dispensing larvae pink bollworm. Then slowly and gradually the population starts rebuilding up and reaches its peak, a larger one of moth catches 1st Fortnight 18.6 and 2nd Fortnight 19.5 in June 16.37 in July and 12.87 in August respectively.

Table 1: Trap-wise moth catches, Tando Allahyar

Taluka Jhando Marri District Tando Allahyar							
Trap #	**June**		**July**		**August**		**Trap-wise total**
	1st Fortnight	2nd Fortnight	1st Fortnight	2nd Fortnight	1st Fortnight	2nd Fortnight	
Trap 1	20	18	10	12	10	8	78
Trap 2	15	14	12	10	13	8	72
Trap 3	18	25	15	13	8	11	90
Trap 4	21	20	12	15	10	9	87
Trap 5	23	27	10	17	12	13	102
Trap 6	12	15	14	10	15	10	76
Trap 7	19	17	12	9	12	10	79
Trap 8	21	20	15	13	11	13	93
	149	156	100	99	91	82	
Sum of Fortnights	**305**		**199**		**173**		**Total 677**
Monthly Mean Population	**19.06**		**12.43**		**10.81**		

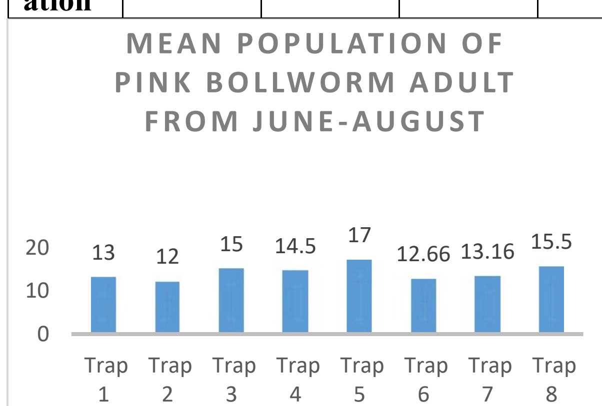

Figure 1: Moth Population Trend Catches Tando Allahyar

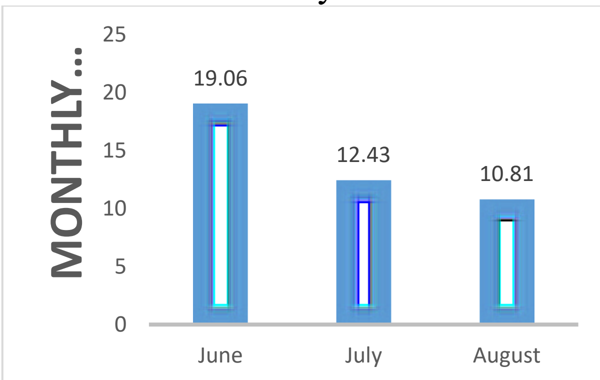

Figure 2: Temperature vs Population Trend, Tando Allahyar

Matiari

The present study revealed that the population of Pink Bollworm varied with the month of the year. It is evident from the results that, except for June, pink bollworm remained active throughout the month of June. The population in June could be attributed to the climatic conditions and temperature reached at 48˚C during June, and in July 46˚C and August max 42˚C or maybe due to the emergence of moths from the dispensing larvae pink bollworm. Then slowly and gradually the population starts rebuilding up and reaches its peak, a larger one of moth catches 1st Fortnight 18.5 and 2nd Fortnight 18.0 in the month of June 16.62 in July and 13.37 in August respectively.

Table 2: Trap-wise Moth Catches Matiari

Taluka Hala District Matiari							
Trap #	**June**		**July**		**August**		**Trap-wise total**
	1st Fortnight	2nd Fortnight	1st Fortnight	2nd Fortnight	1st Fortnight	2nd Fortnight	
Trap 1	15	16	14	18	16	14	93
Trap 2	18	15	12	15	14	12	86
Trap 3	18	15	20	17	11	13	94
Trap 4	20	12	20	18	15	10	95
Trap 5	19	22	17	15	18	12	103
Trap 6	21	27	19	16	11	15	109
Trap 7	17	20	15	16	9	12	89
Trap 8	20	17	16	14	13	11	91
Total	148	144	133	129	107	99	**Total: 760**
Sum of Fortnights	**292**		**262**		**206**		
Monthly Mean Population	**18.25**		**16.37**		**12.87**		

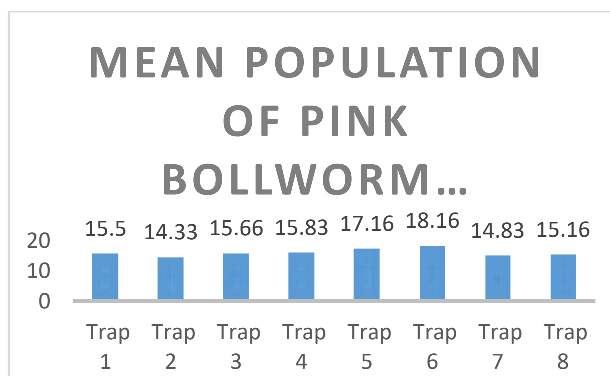

Figure 3: Moth Population Trend Matiari

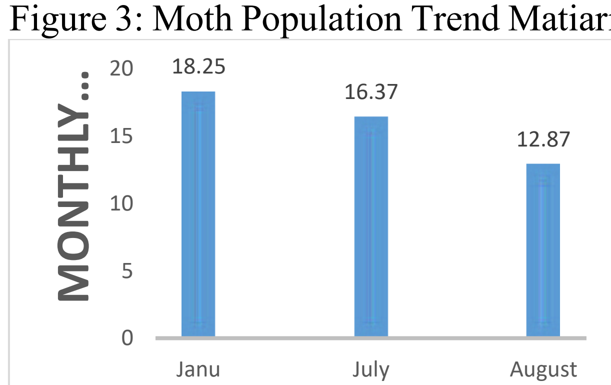

Figure 4: Temperature Vs Population

Trend Matiari

Table 3: Average maximum and minimum temperature recorded during 2019 at Taluka Jhando, Marri District, Tando Allahyar and Taluka Hala District, Matiari

Month	Max. temp (☼°C)	Min. temp (☼°C)	Month	Max. temp (☼°C)	Min. temp (☼°C)
Jun-19	48°	40°	Jun-19	48°	40°
Jul-19	46°	37°	Jul-19	46°	34°
Aug-19	42°	36°	Aug-19	42°	30°

Source: https://www.accuweather.com/

A two-way analysis of variance Table 4 revealed significant differences in the mean number of Pectinophora gossypiella moths (pink bollworm) captured in traps and fortnights during the 2019 cotton season. The effect of trap location was statistically significant 8.42***, indicating that trap location influenced moth abundance. Similarly, a highly significant difference was observed between fortnights 18.03***, suggesting strong temporal variation in moth captures throughout the season. The interaction effect between trap and fortnight 2.25* was also significant, implying that the influence of trap location varied across sampling periods. This interaction suggests that environmental or crop-stage factors may have differentially influenced trap performance over time.

Table 4. Two-factor ANOVA for moth catches of *Pectinophora gossypiella* across traps and fortnights during the 2019 cotton season.

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Trap	71.76042	[illegible]	71.76042	8.423231	0.0047	3.954568
Frotnight	767.8438	[illegible]	153.5688	18.02589	<0.001	2.323126
Trap * Fortnight	95.67708	[illegible]	19.13542	2.246114	0.047	2.323126
Error	715.625	4	8.519345			
Total	1650.906	5				

Overall, these results demonstrate that both spatial (trap location) and temporal (two-week period) factors significantly influenced Pectinophora gossypiella population dynamics, reflecting the combined influence of the field microenvironment and seasonal variation on moth activity.

Correlation analysis Table 5 revealed a positive and statistically significant association between consecutive fortnights in both districts. In Tando Allahyar, higher correlations were observed between the fortnights of June 2 and July 2 (r = 0.83) and between June 1 and July 2 (r = 0.73), indicating consistent pest population trends at the beginning and mid-season. In contrast, correlations at the end of the season (August fortnight) were weaker, even negative, suggesting a decline or fluctuation in mite activity towards the end of the cotton season.

Table (Annexure A)

Similarly, in Matiari, the trend was less pronounced but still exhibited moderate positive correlations between July 2 and August 2 (r = 0.61), implying similar temporal dynamics. Global trends mark the seasonal variability of Pectinophora gossypiella, influenced by climatic and agronomic factors.

Conclusion

There are many sampling techniques of insect collection, active as well as passive. However, Pink Bollworm Adult Moths are collected exclusively through light traps and play an important role in the field sampling of Pink Bollworm Adult Moths populations. Pink Bollworm Adult Moths capture light trap source and design are highly variable and are affected by a wide range of factors. Therefore, while installing a light trap, environmental conditions, trap design, height of the light source and attraction Hand light torch source must be taken into consideration. The light trap's success depends on the intensity and wavelength of the light source. Most insects are attracted to a particular range of wavelengths. Also, high-voltage light

References

Aguiar, A. P., Santos, B. F., 2010. Discovery of potent, unsuspected sampling disparities for Malaise and Möricke traps, as shown for Neotropical Cryptini (Hymenoptera, Ichneumonidae). Journal of Insect Conservation 14, 199–206.

Ahmed, Z., 1980. Incidence of major cotton pests and diseases in Pakistan with special reference to pest management. Proceedings of the International Consultation on Cotton Production Research with Focus on the Asian Region, November 17-21, 1980, Manila, Philippines, pp 156-179.

Ali, M., Z. Ahmad and M.R. Attique, 1982. Effect of the removal of fruiting parts on the yield of four different varieties of cotton in Punjab. Pak. Cottons, 26: 123-130.

Attique, M.R., 1992. Use of sex pheromone for control of bollworm as a part of the integrated pest management programme in Pakistan. Pak. Cottons, 36: 47-56.

Axmacher J C and K Fiedler. 2004. Manual versus automatic moth sampling at equal light sources: A comparison of catches from Mt. Kilimanjaro. Journal of the Lepidopterists' Society, 58: 196-202.

Axmacher J C, G Holtmann, L Scheuermann, G Brehm, K Müller-Hohenstein and K Fiedler. 2004. Diversity of geometrid moths (Lepidoptera: Geometridae) along an Afrotropical elevational rainforest transect. Diversity and

Basset Y, N D Springate, H P Aberlenc and G Delvare. 1997. A review of methods for sampling arthropods in tree canopies. Canopy Arthropods, 35: 27–52.

Bishara, S.I. and M.A. Shakeel, 1982. Estimation of losses in cotton yield due to bollworm damage to bolls in District Multan (Pakistan). Pak. Cottons, 27: 173-176.

Borror, Donald J., 1981. An introduction to the study of insects. Fifth edition. New York. Saunders College Publishing.

Brehm G and J C Axmacher. 2006. A comparison of manual and automatic moth sampling methods (Lepidoptera: Arctiidae, Geometridae) in a rain forest in Costa Rica. Environmental Entomology, 35: 757-764.

Chamberlain, D.J., L.J. McVeigh, B.R. Critchley, D.R. Hall and Z. Ahmad, 1994. The use of pheromones to control three species of bollworm in Pakistan. Proceedings of the World Cotton Research Conference-1: Challenging the Future, February 14-17, 1994, Brisbane, Australia, pp 419-422.

Clive Pankhurst (2006) 3 Redgum Place, Aberfoyle Park, Adelaide, SA 5159 Telephone: 08 8270 5313 Email: cpankhurst@vtown.com.au A report prepared for the Sugar Yield Decline Joint Venture. Distributions, 10: 293-302.

Fiedler K, Schulze CH (2004) Forest modification affects diversity (but not dynamics) of speciose tropical pyraloid moth communities. Biotropica 36: 615–627.

Ghosh, S. K., 2001, G. M. Crops: Rationally irresistible, Curr. Sci., 6: 655-660.

Holloway, J.D., Kibby, G., Peggie, D., 2001. The families of Malaysian moths and butterflies. Fauna Malesiana Handbook 3. Brill (Leiden, Boston, Köln).

Holyoak M, V Jarosik and I Novak. 1997. Weather-induced changes in moth activity bias measurement of long-term population dynamics from light trap samples. Entomologia Experimentalis et Applicata, 83: 329-335. https://gallup.com.pk/intern-publication-3-cotton-production-in-pakistan/

Kitching, I.J., Cadiou, J.M., 2000. Hawkmoths of the world. The Natural History Museum, London. Cornell University Press, London.

Lindquist, Evert, E., 1983. Potential of broad-spectrum predatory mites in open systems. In biological control of pests by mites. Proceedings of a conference held April 5-7, 1982, at the University of California, Berkeley, eds. Hoy et al., Berkeley, California: Agricultural Experiment Station, Division of Agriculture and Natural Resources, University of California.

Liu Y, J C Axmacher, Li L, Wang C and Yu Z. 2007. Ground beetle (Coleoptera: Carabidae) inventories: A comparison of light and pitfall trapping. Bulletin of Entomological Research, 97: 577-583.

Malaise, R., 1937.A new insect trap. Entomologisk tidskrift 58, 148-160.

Marinoni, R. C., Dutra, R. R. C., 1997. Famílias de Coleoptera capturadas com armadilha malaise em oito localidades do Estado do Paraná, Brasil. Diversidades alfa e beta. Revista Brasileira de Zoologia, Curitiba 14, 751–770.

Mason, M., Bordera, S., 2008. Effectiveness of two sampling methods used for collecting Ichneumonidae (Hymenoptera) in Cabaneros National Park (Spain). Eur. J. Ent. 26.

McGavin G.C., 2007. Expedition Field Techniques: Insects and other terrestrial arthropods. Geography Outdoors: the centre supporting field research, exploration and outdoor learning. Royal Geographical Society, Kensington Gore, London.

Morton R, L D Tuart and K G Wardhaugh. 1981. The analysis and standardization of light-trap catches of Heliothis armiger (Hübner) and H. punctiger Wallengren (Lepidoptera: Noctuidae). Bulletin of Entomological Research, 71: 207-225.

Nag A and P Nath. 1991. Effect of moonlight and lunar periodicity on the light trap catches of the cutworm Agrotis

Patil, S. B., 2003, Studies on management of cotton pink bollworm Pectionophora gossypiella (Saunders) (Lepidoptera: Gelechiidae). Ph. D. Thesis, Univ. Agric. Sci., Dharwad (India).

Ricklefs R E. 1975. Seasonal occurrence of night-flying insects on Barro Colorado Island, Panama Canal Zone. Journal of the New York Entomological Society, 83: 19-32.

Southwood, T.R.E.; Henderson, P.A. 2000: Ecological methods. Blackwell Science Ltd, Oxford.

Szentkiralyi, F., 2002. Fifty-year-long insect survey in Hungary: T. Jermys' contribution to light trapping. Acta zoologica acadamiae scientarum Huneraicae 48, 85-105.

Szentkiralyi, F., 2002. Fifty-year-long insect survey in Hungary: T. Jermys' contribution to light trapping. Acta zoologica acadamiae scientarum Huneraicae 48, 85-105.

Walkden, H. H., Whelan, D.B., 1942. Owlet moths (Phalaenidae) taken at light traps in Kansas and Nebraska. U.S. Dept. Agr. Cir. 643, 16.

Table 5. Pearson Correlation Matrix for Moth Catches

			1st Fortnight	*2nd Fortnight*	*1st Fortnight*	*2nd Fortnight*	*1st Fortnight*	*2nd Fortnight*
Taluka Jhando Marri District Tando Allahyar	June	1st Fortnight	1					
		2nd Fortnight	0.685289	1				
	July	1st Fortnight	-0.38872	-0.04692	1			
		2nd Fortnight	0.734101	0.833072	-0.24927	1		
	August	1st Fortnight	-0.57685	-0.57902	-0.08368	-0.42114	1	
		2nd Fortnight	0.437495	0.678618	0.324337	0.509666	-0.05911	1
Taluka Hala District Matiari	June	1st Fortnight	1					
		2nd Fortnight	0.524587	1				
	July	1st Fortnight	0.006972	-0.0846	1			
		2nd Fortnight	0.341242	0.162571	0.453091	1		
	August	1st Fortnight	-0.3136	-0.38992	0.165302	0.1248	1	
		2nd Fortnight	0.188753	0.447437	0.43422	0.608489	0.097375	1