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Survey and population fluctuation of Lesser date moth, *Batrachedra amydraula* Meyrick (Lepidoptera: Batrachedridae) on prominent aseel variety of Date palm

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Abstract

A survey and laboratory-based study were conducted on *Phoenix dactylifera* L. from six locations of district Khairpur during March to June 2019. From all locations due to insufficient nutrients, climatic factors, and *Batrachedra amydraula* infestation on the dropped and unripen fruits of date palm were kept under observation. The overall minimum to a maximum mean of dropped fruits from date palm tree was reported from taluka Khairpur (282.49±24.52), Kingri (337.65±21.11), Kot-Diji (412.89±30.79), Gambat (492.20±45.43), Sobho Dero (547.01±53.72), and Faiz Ganj (589.03±0.43). But in the case of lesser date moth the minimum infestation recorded from Faiz Ganj maximum Khairpur at (1115.84±192.93), (999.15±181.80), (873.90±170.47), (754.59±154.83), (669.76±145.29), (608.81±0.59), respectively. The minimum dropped fruits percentage found during the last days of April from Khairpur and maximum Faiz Ganj up to (5.00%), (10.00%), (15.00%), (20.00%), (25.00%) (30.00%), and minimum infestation percentage recorded from Faiz Ganj, maximum from Khairpur during same days at (70.00%), (75.00%), (80.00%), (85.00%), (90.00%), (95.00%), respectively. It was concluded that only this region of Sindh, Pakistan is the main hub for dates production and playing a pivotal role in Pakistan's economy but the fruit of date orchards from beginning to harvest severely infested by LDM which is a potential pest and voracious feeder of date's fruit and the larvae of this pest enters inside the fruit by forming hole like appearance and finally infest fruits. Therefore; it is recommended that the population of this pest is immediately managed through IPM eco-friendly techniques.

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Introduction

In the history of the world, the Date palm (*Phoenix dactylifera* L.) is one of the oldest sweetest, full nutrient fruit crops, about 7000 years ago it had been cultivated in the Middle East and North America (Flower *et al.*, 2019). It is the oldest thought that this valuable crop had been initiated from Mesopotamia, Southern Iraq but their exact origin is still unknown, according to one thought this fruit had been originated from western India and their cultivation spread all over Arabian Peninsula (Wrigley, 1995). In the history of Egypt, date palm had spread during the middle of the 2nd millennium BCE, later through the expansion of Islam well spread and subsequently reached Spain and Pakistan. It was the Spanish who first introduced the date palm outside from the Arabian Peninsula to the Middle East, South Asia, North Africa, and America (Nixon, 1951). The date palm can be cultivated in different parts of the world but ten countries namely; Saudi Arabia, Libya, Egypt, Oman, Iran, Sudan, United Arab Emirates, Algeria, Tunisia, and Pakistan are top producers amongst the rest but this important fruit is regularly attacked by a lot of disease and pests also insufficient location, cultural practices, weather and no crop rotation (Carpenter and Elmer, 1978). At present in more than thirty-seven countries of the world cultivates dates and about five thousand varieties are available (Akhtar *et al.*, 2014). But in the case of Pakistan three hundred varieties had been cultivated and all these varieties possess biochemical, morphological differentiation, and genetic diversity (Markhand *et al.*, 2010). Pakistan ranks 6th position after Saudi Arabia, Algeria, Egypt, Iraq, and Iran and in the case of Sindh province of Pakistan only district Khairpur shares 34% and In Pakistan, Sindh province share 83.33% again this% is gradually increasing day by day in this region (Abdul-Soad *et al.*, 2010).

The lesser date moth, *Batrachedra amydraula* Meyrick (Lepidoptera: Batrachedridae) having vernacular names such as, "Humeria" and it is an Arabic word with meaning reddish-brown or purely red color (Perring *et al.*, 2015) and "Hashaf" meaning empty fruit, this name comes from their feeding behavior on dates (Sohn *et al.*, 2009).

This pest insect widely harming dates fruits in Oman Sultanate, United Arab Emirates, Saudi Arabia, Yemen, Iraq, Pakistan, and several other countries especially cause damage to young developing fruits (Latifian and Nejadian, 2009). It means lesser date moth severely damages stored and field conditions but injurious effects found on variety under various conditions and this pest is denoted as a key pest of sailor and storage dates (Michael, 1970). Like other fruits date palm face diverse production problems and many pests such as *Arenipses saabella*, *Oryctes rhinoceros*, *Rhynchophorus ferrugineus* and *Batrachedra amydraula* hits this fruits abundantly (Baloch *et al.*, 1992). The Batrachedridae family includes 150 species and widely these species found in tropical regions interesting these species shows morphological affinities with other such as; Cosmopterygidae, Momphidae and Coleophoridae families they are collectively called Micro-Lepidoptera (Priesner, 1989).

The eggs of this pest are light yellow, small-sized, and commonly laid on the immature fruits. The larvae of LDM feed on young fruit and after fruit reaching it enters from the top by forming silt like appearance. By the feeding of host fruits, larvae full-grown, and reaches at 10- 12 mm long (Harhash *et al.*, 2003). Generally, the larvae of pest insects are voracious feeder (Mangrio *et al.*, 2019) feed on young influences cause injury to the fruit, and 80% fruit damage occurs (Dowson, 1982). It was commonly observed the larvae of this pest penetrate near the calyx region of the fruit and faecal material attaches at the penetration site, indicating visible diagnostic damage appearance as larvae grow increase feeding potential (Talhok, 1983). This pest commonly lay eggs on bunches surface, therefore, early covering bunches is the preventive tool from oviposition. Sanitation of the date garden by removing fallen fruit to the surface on the land after harvest by the application of this strategy we can secure the date palm from future pest harbourages (Harhash *et al.*, 2003).

By the application of these practices, we can restrict the further developmental stages of lesser date moth because this pest commonly shows their harmful

activities during early inflorescences rather than mature fruits (Eitam, 2001). The main objective of the present research work was to determine the peak population fluctuation of *B. amydracula* from different talukas of this region. Insecticides applications are the effects for the purpose to minimize the population of this pest but wide usage of toxic insecticides against LDM may enhance resistance power. However, little work has been done to find out the population abundance of this pest. The covering bunches with porous plastic cloth, the flower with paper, thinning fruit, using metal rings for fruit separation from bunches, and mechanical fruit protection also field sanitation are the main component for pest reduction.

Materials and methods

Data collection site

The data of *Batrachedra amydracula* was collected from six talukas of the district; Khairpur namely, Faiz Ganj, Sobho Dero, Gambat, Kot Diji, Kingri, and Khairpur, from March to June 2019. For the purpose to observe the pest population of this pest insect the infested dates were collected through weekly intervals basis and brought under laboratory conditions at Date palm Research Institute (DPRI) Shah Abdul Latif University Khairpur, Sindh.

Field observation strategies/techniques

From each site of all talukas one progressively and well date palm knowledgeable farmer was selected and data were collected date forms beginning up to the harvesting of the dates crop. During the field, observation focus was given to check the infestation density and activity throughout the fruiting period. From the date from only one acre was selected and put under observation and randomly only 25 plants were highlighted/tagged with red cloth ribbon and kept under observation.

Sampling method

The fallen fruits on the ground were taken thoroughly for counting of infestation and fallen fruits were collected and counted at weekly intervals. During this method, damaged fruits separated and damaged percent were observed during the field survey.

Mass rearing of *B. amydracula* under laboratory condition

The data was collected mostly insecticides free plants for the purpose to identify proper infestation percentage. The dropped fallen fruit was collected and kept in laboratory observation for emergence parasitoids. Initially, infested fruits were placed in jars and after the passing of every 24 hours fruits were observed through a magnifying glass for the examination of the LDM population and parasitoids emergence. When larvae were found they were given dates as a food source for further development. Later on; percent of infestation and parasitoid emergence percentage observes as given formula,

$$\text{Percentage\%} = \frac{\text{No. of undamaged fruits}}{\text{No. of damaged fruits}} \times 100$$

Statistical analysis

The statistical data of all talukas were analyzed and ANOVA was done through the random complete design, and means were separated by the least significant difference LSD among the homogenous groups through student package statistical software 8.1 USA version.

Results and discussion

Batrachedra amydracula population fluctuation at Faiz Ganj, Sobho Dero, and Gambat talukas of District: Khairpur

During the present work, the population of LDM was observed in all consequents months but within certain variations. The minimum pest insect population were observed during 1st week from Faiz Ganj at (10.70±0.82), Sobho Dero (19.08±0.66), Gambat (31.48±0.50), and maximum pest infestation during 8th and 9th week at (1662.28±6.47), (1796.04±5.20), (1939.80±5.07), respectively (Table 1). In the same talukas due to climatic influence minimum dropped dates on the ground were found during 1st week at (96.10±0.90), (108.12±0.56), (125.84±0.61), and maximum during the 11th, 12th, 13th week at (966.76±4.83), (860.28±7.37), (767.36±4.44), respectively. The analysis of variance for LDM shows significant difference (DF= 2, 15; F= 32.87; P= 0.00) and (DF= 15, 2; F= 416.29; P= 0.00), respectively. Similarly; ANOVA for agro (DF= 2, 15; F= 13.72; P= 0.01) and (15, 2; F= 61.27; P= 0.00), respectively.

Table 1. Overall mean and SD of agro and LDM at Faiz Ganj, Sobho Dero and Gambat.

Weeks	Faiz Ganj		Sobhodero		Gambat	
	Agro	LDM	Agro	LDM	Agro	LDM
1	96.10±0.90	10.70±0.82	108.12±0.56	19.08±0.66	125.84±0.61	31.48±0.50
2	222.04±2.49	55.52±1.27	239.01±2.16	59.75±1.23	230.20±2.28	98.64±1.32
3	299.22±2.00	128.27±1.22	313.64±1.94	134.44±1.65	310.76±1.92	167.32±1.48
4	432.88±3.37	233.08±3.39	445.95±2.03	240.13±4.69	429.66±3.28	286.424±4.25
5	578.76±2.96	473.52±5.00	589.68±4.67	482.48±4.84	495.96±5.16	606.20±5.94
6	705.48±5.83	862.28±6.60	714.28±4.97	872.96±5.68	646.91±6.27	970.33±6.81
7	788.72±6.25	1183.08±7.38	697.49±5.85	1295.27±6.44	606.84±7.89	1415.92±5.73
8	712.40±5.12	1662.28±6.47	598.68±5.32	1796.04±5.20	484.92±3.47	1939.80±5.07
9	699.90±5.26	1633.02±5.37	588.52±3.98	1765.56±4.27	476.84±3.69	1907.24±4.32
10	784.12±4.93	1176.16±5.05	693.12±4.66	1287.20±5.36	603.12±4.62	1407.24±5.02
11	966.76±4.83	790.96±5.15	789.32±11.27	964.72±17.52	713.60±13.90	1070.44±15.60
12	926.12±5.87	617.44±5.52	860.28±7.37	703.84±7.68	717.36±10.14	876.76±8.73
13	873.80±4.30	470.52±4.85	819.12±7.15	546.08±6.21	767.36±4.44	627.84±5.76
14	735.92±4.97	315.36±5.20	696.60±6.22	375.12±5.48	661.04±6.06	440.68±5.42
15	445.88±7.33	111.48±8.64	433.28±9.79	144.44±9.85	425.40±11.24	182.32±8.74
16	156.36±3.29	17.36±1.53	165.04±2.55	29.12±1.71	179.32±2.18	44.84±1.81
Mean±SD	589.03±0.43	608.81±0.59	547.01±53.72	669.76±145.29	492.20±45.43	754.59±154.83

Prevalence of Batrachedra amydraula at Kot Diji, Kingri, and Khairpur talukas

The population of LDM found greater in Kot Diji, Kingri, and Khairpur location as compared to locations described in (Table 1). Here, the pest population was observed with intense fluctuations. The less infestation was recorded in 1st week from Kot Diji at (39.46±0.54), Kingri (49.46±0.52), Khairpur (61.46±0.89), and maximum pest attack during the 8th and 9th week at (2060.48±5.38), (2263.27±6.28), (2446.00±7.65), respectively (Table 2). In the same

locations the fallen dates due to climatic factor minimum observed during 1st week at (157.86±0.60), (197.86±0.58), (245.86 ± 0.78) and maximum during the 13th week at (574.08±3.88), (519.84±4.46), (463.56±4.63), respectively.

The ANOVA of all pairwise homogenous groups of LDM found with significant difference (DF= 2, 15; F= 47.26; P= 0.00), (DF= 15, 2; F= 946.09; P= 0.00) and agro analysis of variance (DF= 2, 15; F= 17.75; P= 0.00), (DF= 15, 2; F= 7.15; P= 0.00), respectively.

Table 2. Overall mean and SD of agro and LDM at Kot Diji, Kingri, and Khairpur.

Weeks	Kot Diji		Kingri		Khairpur	
	Agro	LDM	Agro	LDM	Agro	LDM
1	157.86±0.60	39.46±0.54	197.86±0.58	49.46±0.52	245.86±0.78	61.46±0.89
2	258.0±2.43	110.64±1.18	293.20±2.33	125.64±1.33	335.48±2.57	143.76±1.26
3	310.84±1.83	207.24±2.04	312.44±1.51	255.64±2.13	251.22±2.12	376.86±1.92
4	415.84±3.61	340.24±3.91	322.44±4.33	483.64±5.91	259.84±2.57	606.24±4.56
5	456.84±7.43	685.32±9.76	357.64±5.32	834.52±5.95	250.44±8.91	1001.72±10.91
6	497.17±5.75	1160.07±7.14	341.44±7.09	1365.80±6.32	265.10±5.11	1502.14±6.82
7	412.56±3.53	1650.20±4.45	316.92±4.37	1795.84±5.83	217.28±4.96	1955.48±6.24
8	369.72±4.10	2095.00±6.15	251.45±4.60	2263.27±6.28	128.72±5.68	2446.00±7.65
9	363.60±4.98	2060.48±5.38	247.40±6.21	2226.68±7.20	126.68±5.89	2407.40±6.44
10	410.08±4.11	1640.36±5.53	315.08±4.88	1785.44±5.23	216.04±4.05	1944.56±5.11
11	547.20±9.49	1276.84±19.55	374.80±8.39	1499.24±23.75	293.71±8.37	1664.33±8.95
12	571.96±6.59	1062.16±6.56	421.01±6.91	1263.11±7.18	348.84±6.86	1395.28±8.38
13	574.08±3.88	861.12±4.67	519.84±4.46	965.36±5.87	463.56±4.63	1081.64±5.58
14	627.96±6.11	513.76±6.68	476.68±3.70	715.04±4.76	438.12±4.37	813.60±5.17
15	421.04±9.32	226.68±8.17	418.64±10.70	279.08±8.37	416.76±5.88	340.96±7.23
16	211.32±3.35	52.84±2.33	235.60±2.84	78.56±2.54	262.12±2.94	112.04±3.61
Mean±SD	412.89±30.79	873.90±170.47	337.65±21.11	999.15±181.80	282.49±24.52	1115.84±192.93

Infestation and fallen fruit percentage at Faiz Ganj, Sobho Dero, and Gambat talukas

The LDM infested and agro percentage at Faiz Ganj, Sobho Dero, and Gambat was observed with certain fluctuation. About nearest to harvest infestation found decreased and during mid-season pest

infestation at high potential. In the last week of June minimum infestation recorded from the given location at (9.99%), (15.00%), (20.00%) and maximum during the last week of April at (70.00%), (75.00%), (80.00) detailed description given in (Table 3). Similarly; the minimum fallen fruit

percentage observed during the last days of April at (30.00%), (25.00%), (20.00%), and the maximum fallen fruit on ground percentage in the last days of June moth at (90.01%), (85.00%), (80.00%), respectively. All pairwise analysis of variance of LDM

and agro fallen fruits percentage found least significant difference at (DF= 2, 15; F= 111.01; P= 0.00) (DF= 15, 2; F= 340.18; P= 0.00) and (DF= 2, 15; F= 111.01; P= 0.00) (DF= 15, 2; F= 340.18; P= 0.00), respectively.

Table 3. Overall agro and infested% at Faiz Ganj, Sobho Dero, and Gambat during, 2019

Weeks	Faiz Ganj		Sobhodero		Gambat	
	Agro%	Infested%	Agro%	Infested%	Agro%	Infested%
1	89.99	10.01	85.00	15.00	79.99	20.01
2	80.00	20.00	80.00	20.00	70.00	30.00
3	69.99	30.01	70.00	30.00	65.00	35.00
4	65.00	35.00	65.00	35.00	60.00	40.00
5	55.00	45.00	55.00	45.00	45.00	55.00
6	45.00	55.00	45.00	55.00	40.00	60.00
7	40.00	60.00	35.00	65.00	30.00	70.00
8	30.00	70.00	25.00	75.00	20.00	80.00
9	30.00	70.00	25.00	75.00	20.00	80.00
10	40.00	60.00	35.00	65.00	30.00	70.00
11	55.00	45.00	45.00	55.00	40.00	60.00
12	60.00	40.00	55.00	45.00	45.00	55.00
13	65.00	35.00	60.00	40.00	55.00	45.00
14	70.00	30.00	65.00	35.00	60.00	40.00
15	80.00	20.00	75.00	25.00	70.00	30.00
16	90.01	9.99	85.00	15.00	80.00	20.00
Mean±SD	60.31±4.48	39.69±4.48	56.56±4.66	43.44±4.66	50.62±4.57	49.38±4.57

Infestation and fallen fruit percentage at Kot Diji, Kingri, and Khairpur talukas

The fallen fruit agro and LDM percentage found high as compared to (Table 3). At the beginning season of the fruits during the early days of March LDM percentage observed low at Kot Diji (20.00%), Kingri (20.00%), Khaipur (20.00%) and a high percentage of infestation during the last week of April at (85.00%), (90.00%), (95.00%) described in (Table 4). Whereas; the minimum

fallen fruit percentage observed during the 4th week of April at (15.00%), (10.00%), (5.00%) and high fallen fruit percentage during 1st week of the March at (80.00%), (80.00%), (80.00%), respectively. ANOVA of all pairwise homogenous groups of LDM and fallen fruits percentage found with significant difference at (DF= 2, 15; F= 56.65; P= 0.00) (DF= 15, 2; F= 135.93; P= 0.00) and (DF= 2, 15; F= 43.74; P= 0.00) (DF= 15, 2; F= 113.67; P= 0.00), respectively.

Table 4. Overall agro and infested% at Kot Diji, Kingri, and Khairpur during, 2019.

Weeks	Kot Diji		Kingri		Khairpur	
	Agro%	Infested%	Agro%	Infested%	Agro%	Infested%
1	80.00	20.00	80.00	20.00	80.00	20.00
2	70.00	30.00	70.00	30.00	70.00	30.00
3	60.00	40.00	55.00	45.00	40.00	60.00
4	55.00	45.00	40.00	60.00	30.00	70.00
5	40.00	60.00	30.00	70.00	20.00	80.00
6	30.00	70.00	20.00	80.00	15.00	85.00
7	20.00	80.00	15.00	85.00	10.00	90.00
8	15.00	85.00	10.00	90.00	5.00	95.00
9	15.00	85.00	10.00	90.00	5.00	95.00
10	20.00	80.00	15.00	85.00	10.00	90.00
11	30.00	70.00	20.00	80.00	15.00	85.00
12	35.00	65.00	25.00	75.00	20.00	80.00
13	40.00	60.00	35.00	65.00	30.00	70.00
14	55.00	45.00	40.00	60.00	35.00	65.00
15	65.00	35.00	60.00	40.00	55.00	45.00
16	80.00	20.00	74.99	25.01	70.06	29.94
Mean±SD	44.38±5.10	55.62±5.10	37.50±5.40	62.50±5.40	31.88±5.63	68.12±5.63

The overall mean of different predators population at different taluka levels

During field conditions, different species of predators were observed from all given location with a variation. From Faiz Ganj predators population observed namely; Spiders, Beetles, Orius, Chrysopa, Geocorus (2.75), (1.13), (0.97), (0.63), (0.67), Sobha Dero (2.94), (1.36), (1.05), (0.75), (0.71) Gambat (3.13), (1.49), (1.24), (0.79), (0.81) Kot Diji (3.30), (1.61), (1.46), (0.89), (0.84) Kingri (3.71), (2.06), (1.84), (1.13), (1.01) Khairpur (3.85), (2.19), (2.00) (1.22), (1.05). At all talukas levels, the minimum population of Geocorus and Chrysopa were observed whereas the Spiders population found at high from all locations. The overall mean of Spiders found at (3.28±0.18), Beetles (1.64±0.17), Orius (1.43±0.17) Chrysopa (0.90±0.09) Geocorus (0.85±0.06), respectively, and overall predators population shown in (Fig 1). The predators population analysis of variance among all pairwise shows with significant difference (5, 4; F= 31.58; P= 0.00) (4, 5; F= 342.98; P= 0.00) homogenous groups.

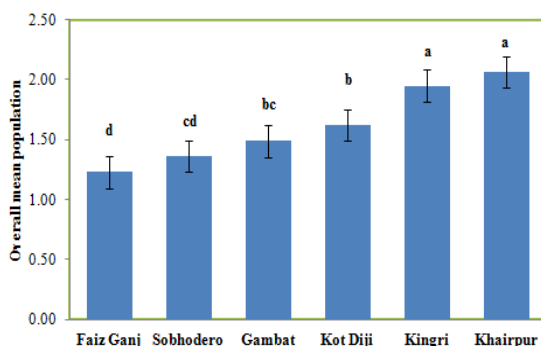


Fig. 1. Overall mean population of predators on date palm fruits at different taluka levels of district Khairpur, Sindh during, 2019.

During present research work, it was frequently observed that due to climatic factor unripened fruit fall on the ground surface but dates fruit also falls and damaged due to the influence of pest insect LDM. Khairpur district is regarded as Queen of date palm or “Khajeen jo dees” in Pakistan. This region is the economic source for the thousands of labor force and families by producing abundant date fruits production with the agreement of (Kakar *et al.*, 2010). Date palms are evergreen, woody plants having a long

reproductive cycle and potential power to sufficiently grow under semi-arid and arid climatic conditions (Alwahshi, 2019). Date palm fruits are more sweet able amongst other fruits and many cultivars are engaged to this all over the world (Fakir *et al.*, 2018). Dates have been found rich with sweets, widely used in chocolates, preservatives, confectionery, breakfast creels, baking products, sauces, salads, and several other food technologies. In Pakistan, the date palm covers about 84,700 only in Sindh 29,300 hectares, and the country earns total production 426,300 and 201,100 tones (Sayed, 2006-2007).

The climatic condition is sufficient and more peculiar for many date varieties including all but the “Aseel” variety is a very important commercial point due to special in taste. Certain factors badly affect date palm production including, the retention of the old and unproductive plantation, crowding of trees, planting of mixed cultivars, poor drainage, salt accumulation, improper irrigation, imbalance fertilizers, disease, pests attack, water scarcity, soil degradation, and certain weeds with the work similarity of (Carpenter, 1981).

This pest insect shows their feeding activities from beginning to postharvest and successfully go through multiple generations more or less comparable with the work of (Hardy *et al.*, 1999). Due to the early seasonal infestation cause significant loss and cause maximum fruit fall may reduce up to 75% yield loss with the work agreement (Blumberg, 1975). *B. amydraula* observed serious pest insect their biological and morphological attributions of this pest is varied in different climatic and in diverse regions of the world and their life cycle cause economical yield losses, frequently in new growing young fruits (Elwan, 2000).

Larvae eat more than a third part of the fruit some time feed the maximum part of the entire content only leaving the outer covering of the fruits and finally by the releasing of silk-like appearance fruits fall on the ground the same finding documented by (Kinawy *et al.*, 2015). The biology, morphology, and taxonomy of this pest are already documented by (Jatoi *et al.*, 2019) from the same location.

In the present work attack observed from March to June, this is more comparable with the work of (Zaid, 1999). Dates fruits in the dry and semi-dry form are cash crop and life earning source of this region.

In this regard, environmentally friendly, cheaper, and safer insecticides should be used in a variety of fruit crops for the betterment of farmers and natural enemies and fruit quantity and quality improvement. The local people of this area are unaware of pest insect fluctuations and infestations. There is a little documentary about the insect pests of dates in this region in this regard present work will be beneficial and informative for the local dates growers to know about the harmful activities of LDM.

Conclusion and recommendations

It was concluded that sweat able climatic conditions are necessary for the growth of date palm plants and yield abundancy. But when the needed based nutrients and other essentials cannot measure to date palm plants then unripened fruits fell on the ground surface and caused yield losses. In the present work, six talukas of district Khairpur were observed and unripened fruit found with a population of LDM pests at different Date palm orchards. The maximum fallen fruits and LDM population was observed in Khairpur and the minimum in Faiz Ganj taluka levels. The larvae of LDM of this pest insect became successful to enter by forming a pore that may attack three to four fruits every day.

It is recommended that if timely removal of fallen fruits and pruning of old bunches should be separated, new bunches should be cover with mass trapping, light clothes, matting disruption then the future population of pest may reduce LDM. Again IPM environmentally friendly techniques should be applied for better management.

Authors' contributions

Experiments designated and conceived: HA Sahito, Experiments performed: FA Jatoi, Data analyzed: WM Mangrio, Tools, materials, analysis arranged: T Kousar, Paper written: HA Sahito, FA Jatoi & WM Mangrio.

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