

## Monitoring of Bio-Fix and Status of Overwintering Population of Codling Moth *Cydia pomonella* L. (Lepidoptera : Tortricidae) by Pheromone Baited Traps in Kargil, Ladakh

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**Abstract** The development of an effective codling moth management strategy requires detailed information on the pest's population density and phenology. Management of codling moth is difficult because it is a mobile pest, generally occurs at low densities and is a direct internal feeder of pome fruits and walnuts. Thus, management decisions based on sampling information requires timely and accurate assessment of its population status. The use of pheromone traps has elevated codling moth monitoring and management to even higher levels of expertise. Pheromone baited traps were used to detect the first emergence and overwintering population status of codling moth in different regions of Kargil district during 2009 and 2010. The results revealed that the first emergence started in May which coincided with the petal fall stage of the fruit crop. Peaks and valleys in the population trend coincided with temperature fluctuations between sampling periods. As temperature in-

creased from May onwards in this region, counts of male moths captured in the traps increased and remained high through the summer and were low in early spring and late summer. Pheromone based monitoring proved to be a sensitive method of forecasting/predicting population status and provided more effective information for making pest management decisions compared with the currently used visual methods of population detection and estimation.

**Keywords** Codling moth, Pheromone traps, Bio-fix, Overwintering population.

### Introduction

Kargil the cold arid region of J & K is located between 32° 56' N latitude and 76° 79' E longitude about 205 km from Srinagar with a total geographical area of about 14 thousand square km. The altitude of the area ranges from 9000 ft to about 14000 ft above m.s.l. The region is characterized by extremes of seasonal temperature ranging from -35°C in winter to +35°C in summer. Besides the region experiences high evapo-transpiration due to low humidity and high velocity winds.

Codling moth, *Cydia pomonella* L. is the predominant and key pest of apple, widely distributed in all the fruit growing areas of Ladakh. The alternate host is pear and walnut but the larvae may also attack plum, apricot, carabapple, quince, and other fruits. The damage caused by the pest is enormous but its distri-

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bution is restricted to Ladakh region of J & K state. The pest has entered into Ladakh from North West Frontier Province of Pakistan where it is reported as serious pest on deciduous trees [1, 2]. All the cultivars of apple indigenous and introduced both are reported seriously infested by pest with varying degree of susceptibility. *Cydia pomonella* L. completes 1-2 generations in one season in Ladakh region. Mature codling moth larvae overwinter in silken cocoons under loose bark in cracks and crevices, in the soil or in wooden materials (bins, ladders, poles, buildings, large prunings) or beneath stones beside infested trees. Pupation starts during the month of April and adult emergence takes place during early May and continues up to last week of August depending upon temperature.

In Ladakh region, villages and hamlets are scattered and isolated. Due to small size of land holdings in the fruit producing areas, there are no well established and regular orchards, instead the fruit trees particularly apricot and apple stand closely planted along the bunds of fields under cereals, vegetables or field crops and also on barren land. Moreover, the apple trees in the region have a spreading habit and are kept untrained, unpruned and unmanaged. Therefore, under such circumstances it is necessary to study the first emergence and population status of codling moth for proper timing of different components of pest management strategies like cultural control, timing of insecticides, release of bio-agents. The use of pheromone technology for assessment of first emergence and overwintering population status will be fairly easy to control such pest because it will determine the times of first flight (biofix) and of peak periods of flight for the pest [3]. That is why the present studies were undertaken to evaluate the potential of pheromone traps in assessment of seasonal activity of the pest.

### Materials and Methods

Field experiments were performed in three major fruit growing areas of the Kargil region viz., Karkitchoo, Hardass and Shilikchey during 2009 and 2010 in which pheromone traps were installed for monitoring the seasonal activity of codling moth, in respect of biofix and status of overwintering population. Traps and

pheromone lures used in the trials include delta traps and Codlemone from M/S AG Bio Systems Pvt Ltd Secunderabad. Each field trial included a plot (covering an area of about 0.5 acre) with 10 apple trees, distributed randomly within the plot among the apricot trees, with each tree using one pheromone trap to obtain ten independent replications. Traps baited with codlemone were placed in upper half of tree canopy and separated 20-25 m apart. The traps were installed in all the locations during second fortnight of April, i.e., pink bud stage and they remained in the field until the end of August. However, the lures along with the septa or liners were replaced 30 days after installation. Moths caught were counted and traps rotated every week. Trap catches were accumulated weekly to obtain weekly efficacies and estimations and status of overwintering population of the pest in relation to weather parameters particularly temperature.

### Results and Discussion

The results of weekly trap catches of *C. pomonella* for different locations during 2009 and 2010 are depicted in Table 1. The results revealed that the first emergence of moths (biofix) was noticed in 2<sup>nd</sup> week (19<sup>th</sup> standard week) and in last week of May (21<sup>st</sup> standard week) during 2009 and 2010 respectively, at all the three locations. The difference in the adult emergence observed was attributed to the fluctuation in temperature as during 2010 the cold weather prevailed even during entire May.

During 2009 the average number of moth catches/trap/week differed significantly ( $p < 0.01$ ) at all the location from the date of biofix to complete absence of moth catches and was observed as 9.72, 11.11 and 10.62 moths/trap/week at these locations, respectively. The trap catch was observed to increase from first week of June and attained a peak value (37.07 moths/trap/week) during the 3<sup>rd</sup> week of June (25<sup>th</sup> standard week) at all the locations. Thereafter, the trap catch was observed to decrease slowly during the month of July and by the beginning of August the trap catch decreased abruptly and no moth emergence was reported during the last week of August. This was attributed to the end of overwintering generation.

**Table 1.** Seasonal activity of codling moth (*Cydia pomonella* L.) depicting first emergence (bio-fix) and overwintering population status in Kargil, during 2009 and 2010. Each figure is a mean of 10 replications.

Standard weeks	Sampling date	Mean number of moth catches/trap/week 2009				Standard weeks	Sampling date	Mean number of moth catches/trap/week 2010			
		Kirkatcho	Hardass	Shilikchey	Mean			Kirkatcho	Hardass	Shilikehey	Mean
15	14.04.09	0.00	0.00	0.00	0.00	15	15.04.10	0.00	0.00	0.00	0.00
16	20.04.09	0.00	0.00	0.00	0.00	16	21.04.10	0.00	0.00	0.00	0.00
17	27.04.09	0.00	0.00	0.00	0.00	17	28.04.10	0.00	0.00	0.00	0.00
18	04.05.09	0.00	0.00	0.00	0.00	18	05.05.10	0.00	0.00	0.00	0.00
19	11.05.09	1.65	2.00	3.25	0.00	19	12.05.10	0.00	0.00	0.00	0.00
20	18.05.09	2.35	3.5	4.50	3.45	20	19.05.10	0.00	0.00	0.00	0.00
21	25.05.09	3.62	4.87	3.00	3.83	21	26.05.10	2.62	3.87	4.00	3.50
22	01.06.09	4.63	5.00	6.25	5.29	22	02.06.10	5.62	8.37	7.63	7.21
23	08.06.09	13.5	22.87	15.50	17.29	23	09.06.10	12.13	16.50	18.6	15.74
24	15.06.09	23.38	26.75	27.50	25.88	24	16.06.10	22.75	26.86	25.25	24.95
25	22.06.09	34.5	40.20	36.50	37.07	25	23.06.10	30.00	35.4	37.5	34.30
26	29.06.09	25.25	29.00	26.00	26.75	26	30.06.10	24.00	23.26	25.00	24.09
27	06.07.09	15.75	12.25	17.00	15.00	27	07.07.10	12.75	10.5	13.40	12.22
28	13.07.09	10.37	9.70	8.25	9.44	28	14.07.10	5.75	5.25	7.00	6.00
29	20.07.09	6.50	7.18	7.25	6.98	29	21.7.10	3.37	4.70	5.25	4.44
30	27.07.09	1.12	1.25	2.00	1.46	30	28.07.10	2.50	3.18	2.00	1.46
31	03.08.09	2.13	1.62	1.25	1.67	31	04.08.10	2.13	1.62	4.25	1.67
32	10.08.09	0.5	0.25	0.37	0.37	32	11.08.10	0.50	0.25	0.37	0.37
33	17.08.09	0.5	0.25	0.37	0.37	33	18.08.10	0.50	0.25	0.37	0.37
34	24.08.09	0.00	0.00	0.00	0.00	34	25.08.10	0.00	0.00	0.00	0.00

Similar trend for biofix and status of overwintering population was recorded during 2010 at all the three locations. The average number of moth catches per trap per week was observed as 9.58, 10.77 and 11.52 at these locations respectively. The trap catch was observed to increase from second week of June and attained a peak (34.30 moths/trap/week) during last week of June (25<sup>th</sup> standard week) at these locations. During the study it was also observed that with the change of fresh lures during peak moth emergence the maximum numbers of moths were trapped at all the locations. The trap catch was observed to decrease significantly ( $p < 0.05$ ) from first week of July and reduced to nil during last week of August.

The results further revealed that adult emergence and status of overwintering population of codling moth is temperature dependant which started in 2<sup>nd</sup> week of May during 2009 and last week of May during 2010 and increased gradually and reached at its peak from mid to ending June. The mean number of moth trap catch/week was high during 2009 as compared to that during 2010 at all the locations. Similar

results were observed in monitoring of codling moth populations by using pear ester in sex pheromone treated orchards [4].

The total number of overwintering moth catches per trap during the season was recorded as 157.14 and 138.17 moths/trap during 2009 and 2010 respectively. It was attributed to the implementation of area wide pest management program from 2009 as earlier the farmers had not been using any pest management strategy for this pest. Maximum trap catch was observed in Hardass, followed by Shilikchey and Kirkatcho during 2009 while as during 2010 it was observed in Shilikchey followed by Hardas and Kirkatcho. Moreover, peaks and valleys in the population trend seemed to coincide with temperature fluctuations between sampling periods. The moth trap catches from August onwards during the study were observed to be as emergence of first generation moths. Similar results were reported in Ladakh region [5]. The results are also in conformity with the findings in a codling moth monitoring project in North Ohio Orchards in USA [6].

Thus, pheromone baited traps provided a useful tool to detect the population trends particularly biofix and overwintering generation, as increase in field populations of this pest often remained undetected by growers until the resulting premature fruit fall occurred due to the well established populations and hence difficult to control. Overall pheromone based monitoring proved a sensitive method of following population cycles and it is suggested that the use of pheromone traps would provide more effective information for making pest management decisions compared with the currently used visual methods of population detection and estimation.

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