



Damage of *Galleria mellonella* in *Apis mellifera* Colonies and Stored Combs

Lalita and Yogesh Kumar

Rice Research Station Kaul, CCS Haryana Agricultural University Hisar-125 004, India
E-mail: lalitaentohau@gmail.com

Abstract: The present investigation was carried out at Chaudhary Charan Singh Haryana Agricultural University, Hisar for two years (2016 and 2017). The comb area damaged by *Galleria mellonella* varied during different months. During both the years, comb area damaged by *G. mellonella* started increasing in April and increased till July. From August, the damaged area started decreasing in different and reached to lowest limit in March. The maximum comb area damaged was in July. During both the years, the mean comb area damaged was lower in stronger colonies as compared to weak colonies. Correlation studies between comb area damaged by larvae in 4, 6 and 8 frame strength and weather parameters showed significant positive correlation with maximum temperature and maximum RH. In stored combs, cumulative comb area damaged per frame increased with the passage of time from June to October. In October, comb area damaged per frame was maximum when ten combs were stored in a hive body followed by 9, 8 and 7 combs whereas the minimum area damaged was in 6 combs. The correlation study indicated significant positive correlation between extent of comb area damaged by wax moth larva with maximum temperature, maximum humidity and non-significant with minimum temperature and minimum RH.

Keywords: Stored combs, Damaged comb area, Bee colonies, Weather parameters

Most serious pest of honey bees, *Galleria mellonella* is cosmopolitan in nature causing serious economic damage to honey bee colonies and combs during storage (Gillard 2009 and Ellis et al 2013). Larvae feed on the wax comb in weak bee colonies or during the storage of wax combs in winter (Caron 1999). Wax moth larvae remains in beehives which feed on wax and young bees, fill the hive tunnels with silk threads and start reducing the web and debris to a mass of combs and fecal matter of the larvae, condition described as "*Galleriasis*." The larvae are especially harmful to colonies that are old or unguarded and to stored combs also. Weak colonies are much more vulnerable to wax moths infestation with especially in comparison with strong colonies (Basavarajappa 2011). The information on comb damage by greater wax moth in *Apis mellifera* colonies is little in stored combs in India. So, keeping these above facts in view, the present study comb area damaged by *Galleria mellonella* in *Apis mellifera* colonies and stored combs and its correlation with weather parameters was planned.

MATERIAL AND METHODS

Five colonies each with 4, 6, 8 and 10 frame bees strength were selected among the apiary with the same queen age and equalized w.r.t bee strength, brood (unsealed and sealed) and food, stores (pollen, nectar and honey). Each comb after brushing off the bees was held against the sunlight and observations at an interval of 21 day were

recording comb damage. Extent of comb area damaged in stored combs (7, 8, 9 and 10 empty combs of without bees) was recorded at fortnightly interval. The comb area damage caused by the larvae of *G. mellonella* was recorded using brood measuring frame having wire grid squares, each measuring one inch squares in size. The number of squares covering the infested area completely or partially were counted as damaged and then converted to cm² by multiplying with 6.45. The experiments were conducted with five replication for recording damage during both the years. Temperature and relative humidity (%) data were collected from observatory of the Department of Agriculture Meteorology, CCS Haryana Agricultural University, Hisar and data were correlated with extent of damage.

Statistical analysis: Data were statistically analyzed with the OPSTAT software system.

RESULTS AND DISCUSSION

Comb area damaged by *G. mellonella* in *A. mellifera* colonies: During 2015-16, the comb area damaged by *G. mellonella* in 4 frame bee strength colonies started increasing in April (212.85 cm²) and increased till July (1376.00 cm²) and there after started decreasing and lowest in March (86.00 cm²) (Table 1). The maximum comb area damaged was in July (1376.00 cm²). The pattern of comb area damage was same in case of 6, 8 and 10 frame bee strength colonies. In 10 frame bee strength colonies started

increasing in April (101.05 cm²) and increased till July (602.00 cm²) and thereafter started decreasing and lowest in March (32.25 cm²). The maximum comb area damaged was in July (602.00 cm²). Irrespective of the bee strength, the maximum comb area damaged (cm²) was recorded in July (1037.38) whereas the minimum in March (61.28). However, the mean area damaged was lowest in 10 frame bee colonies (234.14 cm²) followed by 8, 6 and 4 frame bee colonies. The overall average number of wax moth infected combs in a colony was 1.16 combs which were higher than average infested combs (0.9) reported by Amsalu (2011).

Correlation between weather parameters and comb area damage by *G. mellonella* in *A. mellifera* colonies: During 2015-16, the mean combs damage area in all frame strength (4, 6, 8 and 10) was maximum in July (1037.38 cm²), whereas lowest comb damage in March (61.28 cm²). In 2016-17, maximum damaged area (995.45 cm²) were in July and minimum was in March (54.83 cm²). During year 2015-16, July recorded as maximum temperature (35.10°C), minimum temperature (26.10°C), maximum RH (90%), minimum RH (72%) and number of bright sunshine hour (5.9 hour). In March, maximum temperature (29.90°C), minimum temperature (13.70°C), maximum RH (88%), minimum RH (46%) and number of bright sunshine hour (8.10 hour) were recorded. In 2016-17, weather parameters in July were

recorded as maximum temperature (35.10°C), minimum temperature (27.00°C), maximum RH (88%), minimum RH (67%) and number of bright sunshine hour (6.8 hour). In March, the average of weather parameters were recorded as maximum temperature (29.90°C), minimum temperature (13.70°C), maximum RH (88%), minimum RH (46%) and number of bright sunshine hour (8.10 hour). There was significant positive correlation exists between comb area damage with maximum temperature, maximum humidity and negatively non-significant with minimum temperature and minimum RH (Table 3). In 4- frame bee strength whereas no correlation existed between comb damage and sunshine hours. Significant positive correlation of comb area damage with maximum temperature in 6 and 8 frame bee strength maximum humidity and non-significant with minimum temperature and minimum RH, respectively in year 2015-16 while in year 2016-17, correlation of comb damage with maximum temperature in 6 and 8 frame, maximum humidity and negatively non-significant with minimum RH and positively non-significant with minimum temperature. There was a non-significant correlation between comb area damage by larvae in 10 frame bee strength with maximum temperature, minimum temperature, maximum RH, minimum RH and sunshine hours during 2015-16 and 2016-17. The significant correlation was between the comb area

Table 1. Comb area damaged by *G. mellonella* in *A. mellifera* colonies (cm²)

Mean bee frame strength in different year	Comb area damage in									
	2015-16					2016-17				
Month	4	6	8	10	Mean	4	6	8	10	Mean
November	559.00	462.25	359.05	242.95	405.81	548.25	359.05	301.00	275.20	370.88
December	232.20	152.65	103.35	70.95	138.71	189.20	137.60	73.10	70.95	106.43
January	111.80	101.50	86.00	66.65	92.56	101.05	86.00	70.95	30.10	82.24
February	101.05	86.00	70.95	32.25	72.56	101.05	70.95	70.95	25.80	68.26
March	86.00	70.95	55.90	32.25	61.28	70.95	70.95	55.90	21.50	54.83
April	212.85	150.50	118.25	101.05	145.66	176.30	122.55	118.25	86.00	125.78
May	548.25	425.70	202.10	163.40	334.86	473.00	361.20	172.00	150.50	289.18
June	599.85	488.05	326.80	219.39	408.52	520.30	447.20	236.50	187.05	347.76
July	1376.00	1268.50	903.00	602.00	1037.38	1333.00	1204.00	885.80	559.00	995.45
August	1182.50	1098.65	774.00	464.00	879.79	1019.10	935.25	526.75	376.25	697.14
September	1014.80	922.35	623.50	451.50	753.03	857.85	771.85	457.95	359.00	611.66
October	911.60	774.00	612.75	363.35	657.92	752.50	660.05	436.45	333.25	545.56
Mean	577.99	500.09	352.97	234.14		511.87	435.55	283.8	206.21	
Factors			C.D.					C.D.		
Month			0.62					0.62		
Bee strength			0.35					0.35		
Month × Bee strength			1.24					1.24		

damage with maximum temperature, maximum humidity, and negatively non-significant with minimum RH in 4, 6 and 8 frame strength. Correlation did not exist between comb area damage and sunshine hours in 4, 6, 8 and 10 frames bee strength during both the years. Raghunandan and Basavarajappa (2014) reported infestation in semi-arid region during summer (30.8%) followed by rainy season (23.4%). However, the infestation was less 11.0 and 6.6% during summer and winter seasons respectively in Malnad.

Effects of storing different number of combs on damage by *G. mellonella* during June to October: Data on comb

area damaged by *G. mellonella* by storing different number of combs during June to October in two consecutive years (Table 3). During 2016, data indicated that in case 7 combs were stored, the area damaged per comb was minimum at the time of first observation in mid-June (8.60 cm²). In the following observations, the cumulative area damaged per frame increased till the end of September (169.85 cm²). In October, area damaged did not increased and was almost same as in the end of September. The area damaged per comb was 170.28 and 170.32 cm² in mid-October and end October, respectively. The pattern of damage during different

Table 2. Correlation between weather parameters and comb area damage by *G. mellonella* in *A. mellifera* colonies

Weather parameters	2015-16				2016- 17			
	Number of bee frames covered by bee							
	4	6	8	10	4	6	8	10
Max. temp. (°C)	0.852*	0.767**	0.792**	0.820**	0.793*	0.767**	0.786**	0.817**
Min. temp. (°C)	0.697	-0.635	-0.651	-0.688	-0.635	-0.565	-0.617	-0.659
Max. RH (%)	0.686**	0.222**	0.232**	0.162**	0.645**	0.191**	0.206**	0.144**
Min. RH (%)	-0.267	-0.251	-0.258	-0.240	-0.315	-0.302	-0.290	-0.267
Bright sunshine (hr)	0.130	0.043	0.006	0.023	0.134	0.036	0.003	-0.023

*, ** Significant at 5% and 1% level of significance

Table 3. Effects of storing different number of combs on damage by *G. mellonella* during June to October 2016 and 2017

Number of combs stored	Cumulative comb area damaged per frame (cm ²) in 2016										Mean
	June		July		August		September		October		
	15.6.16	30.6.16	15.7.16	30.7.16	15.8.16	30.8.16	15.9.16	30.9.16	15.10.16	30.10.16	
7 Frame	8.60	12.90	20.43	40.85	96.75	107.50	144.05	169.85	170.28	170.32	94.14
8 Frame	10.75	19.35	25.80	58.05	101.05	122.55	169.85	189.20	189.41	190.00	107.54
9 Frame	12.90	21.50	32.25	79.55	118.25	141.90	180.60	202.10	202.31	202.31	119.36
10 Frame	19.35	23.65	38.70	133.30	139.75	161.25	193.50	219.30	219.51	219.52	136.78
Mean	12.90	19.35	29.32	77.94	113.95	133.30	172.00	195.11	195.38	195.58	-
Factors											C.D.
Month											0.18
Comb number											0.29
Month × Comb number											0.59
Cumulative comb area damaged per frame (cm ²) in 2017											
7 Frame	9.68	13.98	21.50	43.00	101.05	109.65	148.35	174.15	174.36	174.40	97.00
8 Frame	9.57	19.89	27.95	60.20	105.35	126.85	172.00	199.95	200.16	200.16	112.20
9 Frame	15.05	22.58	33.33	81.70	122.55	146.20	182.75	204.25	204.46	204.50	121.73
10 Frame	20.43	24.73	39.78	135.45	141.90	167.70	197.80	223.60	223.81	223.89	139.90
Mean	13.68	20.30	30.64	80.09	117.71	137.60	175.23	200.49	200.70	200.73	-
Factors											C.D.
Month											0.17
Comb number											0.28
Month × Comb number											0.57

Each value represents mean of five observation

Table 4. Correlation of weather parameters with comb area damaged by *G. mellonella* in stored combs

Number of combs stored in different years Weather parameters	Number of combs stored/ hive body							
	2016				2017			
	7	8	9	10	7	8	9	10
Max. temp. (°C)	0.703 [*]	0.767 ^{**}	0.792 ^{**}	0.820 ^{**}	0.704 [*]	0.767 ^{**}	0.786 ^{**}	0.817 ^{**}
Min. temp. (°C)	-0.512	-0.604	-0.651	-0.688	-0.475	-0.565	-0.617	-0.659
Max. RH (%)	0.227 ^{**}	0.222 ^{**}	0.232 ^{**}	0.162 ^{**}	0.222 ^{**}	0.191 ^{**}	0.206 ^{**}	0.144 ^{**}
Min. RH (%)	-0.267	-0.251	-0.258	-0.240	-0.315	-0.302	-0.290	-0.267
Bright sunshine (hr)	0.130	0.043	0.006	0.023	0.134	0.036	0.003	-0.023

*, **Significant at 5% and 1% level of significance

months was same when 8, 9 and 10 combs were stored. At the time of first observation (mid-June), the area damaged per comb (cm²) was significantly higher when 10 combs were stored (19.35) than 9 (12.90), 8 (10.75) and 7 combs (8.60). On 30th October, the area damaged (cm²) was maximum (219.52) when 10 combs were stored followed by 9, 8 and 7 combs. From June to October, the area damaged per comb (cm²) was maximum in case 10 combs were stored followed by 9, 8 and 7 comb storage. The pattern of damage during different months was almost same in year 2017 also i.e. highest damage was recorded in 10 combs were stored followed by 9, 8 and 7.

Correlation of weather parameters with comb area damaged by *G. mellonella* in stored combs: The damage caused by *G. mellonella* in the stored combs of different frames strength (4, 6, 8 and 10 frames) was recorded from June to October 2016 and 2017 (Table 4). This indicated that the mean comb area damaged in all frame was maximum in 30th September (195.11 cm² and 200.49 cm²), whereas comparatively lowest during first fortnight of June (12.90 cm² and 13.68 cm², respectively) during the year 2016 and 2017. The correlation study indicated significant positive correlation of comb area damage with maximum temperature, maximum humidity and negatively non-significant with minimum temperature and minimum RH. Significant positive correlation were in 8, 9 and 10 comb damage with maximum temperature maximum humidity and negatively non-significant with minimum temperature and minimum RH.

There was no significant relation found with the comb damage and sunshine hours during both the year in all frame strength i.e. 7, 8, 9 and 10. Sohali (2017) also reported that the minimum and maximum temperatures were strongly correlated with wax moth abundance and consequently, the percent of hives with moth damaged combs.

CONCLUSIONS

In both the years, the mean comb area damaged was lower in stronger colonies as compared to weak colonies. Correlation between comb area damaged by larvae in 4, 6 and 8 frame strength with the weather parameters showed significant positive correlation with maximum temperature and maximum RH, whereas significant negative correlation with minimum temperature and minimum RH and number of bright sunshine hours. Cumulative comb area damaged per frame was maximum when ten combs were stored in a hive body followed by 9, 8 and 7 combs. There was significant positive correlation between extent of comb area damaged by wax moth larvae and maximum temperature, maximum humidity and non-significant with minimum temperature and minimum RH.

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