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DURATION OF PHEROMONE SPECIFIC BEHAVIOR FOR ATTRACTION OF FEMALE GREATER WAX MOTH (*GALLERIA MELLONELLA* L.)

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ABSTRACT

The study were conducted in the laboratory, Department of apiculture, UAS, GKVK, Bangalore. In the present study effect of different hours of scotophase in attraction of female greater wax moth at different days after emergence was counted. The duration occupied (in sec out of 300 sec) female greater wax moth eliciting different behavioural patterns viz., stationary fanning, ambulation, ambulatory fanning, hovering, searching and circling. The maximum response elicited in case of ambulatory fanning behavior followed by other behaviours, respectively. The behavioural bioassay revealed that the moths of 3 to 5 days old showed maximum responses to the best binary blend of nonanal and undecanal (3:7) during initiation or first quarters of the scotophase. Highest behavioural responses to the best pheromone blend of nonanal and undecanal (3:7) was at 7 pm to 9 pm with more than 60 per cent moths exhibiting pheromone specific behavioural patterns.

INTRODUCTION

Honey bees are highly valued resource-insects around the world. Five species of honey bees are found all over the India viz., *Apis florea, A. cerana, A. dorsata, A. mellifera* and *Trigona iridipennis*. However, only *A. cerana* and *A. mellifera* are reared in hives. Managed honey bee populations are affected by many factors including diseases, parasites, pesticides, environment and socio-economic factors. These factors can act alone or in combination with each other (Vanengelsdorp and Meixner, 2010) in contributing for the loss of colonies and consequently the associated economic benefits. One such major problem is the occurrence of various enemies like hive beetle, wasps, ants, termites, mites, birds, mammals and wax moths, which cause considerable losses. Among the several bee enemies, the greater wax moth, *Galleria mellonella* L. causes the highest loss to the bee keeping industry, as they destroy a large number of combs in the colony, wax foundation sheets and stored combs. The larval stage of the greater wax moth feeds on the wax produced by honeybees. The greater wax moth is responsible for heavy economic losses reaching upto 60 to 70 per cent to bee keepers in developing countries (Kapil and Sihang, 1983 and Hanumanthaswamy *et al*., 2009). Recent studies have been conducted on the use of pheromone traps as part of a pest suppression programme in the control of the greater wax moth (Finn and Payne, 1977; Flint and

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Merkle, 1983). Trap can play important role in integrated management plan because of their safety in providing control without fear of hive product contamination Beekeepers loose large number of Apis cerena colonies every year due to wax moth menace. In view the gravity of the problem with the background of available information following objectives have been drawn to manage wax moth in a way suitable to our local condition. The present investigations were under taken to investigate the duration of pheromone specific behaviour for attraction of female greater wax moth (*Galleria mellonella* L.)

MATERIALS AND METHODS

An investigation was conducted in the laboratory, Department of Apiculture, UAS, GKVK, Bangalore. Initial culture of Greater Wax Moth was obtained from National Bureau of Agriculturally Important Insects (NBAII), Hebbal, Bangalore-560024. The larvae of GWM were reared on artificial diet and comb wax and the culture was maintained in the laboratory for different behavioural studies.

Behavioural bioassay

A single female moth (1-6 days old) was placed in each transparent plastic tube of 5 cm length for behavioural study with different pheromone blends. Trials were conducted between 7 pm to 3 am of the scotophase as per Nelson and Brister (1977) and Romel (1991). The different blends of undecanal and nonanal were prepared by mixing them in acetone using micropipette. The blend of different concentration was prepared at 500 ppm, 1000 ppm and 10,000 ppm in a conical flask. The 1000 ppm blend gave maximum response to female moth, hence, for the present study 1000 ppm blend of undecanal and nonanal was used during entire experimental period. The different blends of undecanal and nonanal viz., 5 per cent nonanal + 95 per cent undecanal, 10 per cent nonanal + 90 per cent undecanal, 15 per cent nonanal + 85 per cent undecanal, 20 per cent nonanal + 80 per cent undecanal, 40 per cent nonanal + 60 per cent undecanal, 50 per cent nonanal + 50 per cent undecanal, 70 per cent nonanal + 30 per cent undecanal, 80 per cent nonanal + 20 per cent undecanal, 90 per cent nonanal + 10 per cent undecanal are used to test the female greater wax moth. Among the different pheromone blends studied, 3:7 pheromone blend of undecanal and nonanal was found most promising and was therefore selected for behavioural bioassay study of female wax moth. Different types of behaviours were observed and recorded over a 5 min period and later transcribed. During photophase, individuals remained inactive with a resting posture with wings held roof-like and antennae extended backward. Several distinct behavioural categories that have been observed for females responding to different pheromone blends are as follows,

Stationary fanning: Fanning while in a stationary position
Ambulation: Running on the tube surface, no wing fanning.
Ambulatory fanning: Running on the tube surface with wing fanning
Hovering: Sustained flight within the tube
Searching: Searching the surface of the glass rod; either with or without wing fanning (walking and turning)
Circling: Running or walking in circles on the side of the glass rod

Above said observations were recorded from 6 pm to morning 3 am @ 30 moths per replication at hourly interval. The activity of moths was taken by using videos at different hours for five minutes.

RESULT AND DISCUSSION

Female moth response to the 3:7 blend of undecanal and nonanal

All the blends used in testing the response for the female moths of GWM. 3:7 blend was eliciting maximum percentage of responsive moth. This results are in conformity with Leyrer and Monoroe (1973) revealed that C11: Al to C9: Al undecanal and nonanal in the ratio of 3:7 ratio plays an important role in attraction of male greater wax moth. The similar in our experiment found that sequence with initiation of the behavior includes fanning with or without ambulatory movement and further moth will exhibith overing/or searching and finally circling prior to mating. In all the timing tested for the behavioral response, it is during first 3 hrs of the scotophase GWM exhibit the maximum response. All the behavioral patterns showed declined trend at later hrs of the scotophase irrespective of the age of the female moth. Considering first 3 hrs of the scotophase tested highest mean percentage of response was registered in case of 4 day old moth followed by 5 day old and 3 day old moth.

Table 1. Mean duration of ambulatory fanning, ambulation and hovering behaviours exhibited by female wax moth exposed to pheromone blend of 3:7 of undecanal and nonanal for duration of 300 sec

Hrs into scotophase	Duration of pheromone specific behavior in seconds																	
	Searching behavior Age of moth in days						Circling behavior Age of moth in days						Stationary fanning behavior Age of moth in days					
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
19.00	26	9	62	42	39	87	70	97	39	50	47	52	25	13	82	52	19	36
20.00	20	52	123	91	103	71	60	75	39	91	32	91	90	65	32	21	21	87
21.00	60	61	62	93	68	136	70	34	76	93	90	102	24	68	23	48	21	10
22.00	90	92	96	77	80	32	64	38	18	10	102	52	12	132	101	70	27	91
23.00	5	5	65	83	35	53	5	75	69	83	42	61	2	38	48	57	91	83
24.00	7	104	125	95	119	32	2	44	10	95	47	71	45	35	22	63	64	41
01.00	4	41	63	100	39	92	12	85	44	100	83	76	3	27	31	31	87	55
02.00	32	16	90	18	93	58	80	73	53	18	91	22	24	31	22	89	63	67
03.00	10	65	10	106	53	103	14	90	29	15	51	48	5	38	68	12	41	23
Mean	28.2	49.4	77.3	78.3	69.9	73.8	41.8	67.8	41.8	61.6	65	63.8	25.5	49.7	47.7	49.2	48.2	54.8
S.D.	29.2	35.3	35.8	29.3	30.7	34.3	32.5	23.3	21.7	38.3	26.1	24.1	27.8	35.4	29.3	24.5	28.8	29.3

Table 2. Mean duration of searching, circling and stationary fanning behaviours exhibited by female wax moth exposed to pheromone blend of 3:7 of undecanal and nonanal for duration of 300 sec

Hrs into scotophase	Duration of pheromone specific behavior in seconds																	
	Ambulatory fanning behavior Age of moth in days						Ambulation behavior Age of moth in days						Hovering behavior Age of moth in days					
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
19.00	26	9	62	42	39	87	70	97	39	50	47	52	25	13	82	52	19	36
20.00	20	52	123	91	103	71	60	75	39	91	32	91	90	65	32	21	21	87
21.00	60	61	62	93	68	136	70	34	76	93	90	102	24	68	23	48	21	10
22.00	90	92	96	77	80	32	64	38	18	10	102	52	12	132	101	70	27	91
23.00	5	5	65	83	35	53	5	75	69	83	42	61	2	38	48	57	91	83
24.00	7	104	125	95	119	32	2	44	10	95	47	71	45	35	22	63	64	41
01.00	4	41	63	100	39	92	12	85	44	100	83	76	3	27	31	31	87	55
02.00	32	16	90	18	93	58	80	73	53	18	91	22	24	31	22	89	63	67
03.00	10	65	10	106	53	103	14	90	29	15	51	48	5	38	68	12	41	23
Mean	28.2	49.4	77.3	78.3	69.9	73.8	41.8	67.8	41.8	61.6	65	63.8	25.5	49.7	47.7	49.2	48.2	54.8
S.D.	29.2	35.3	35.8	29.3	30.7	34.3	32.5	23.3	21.7	38.3	26.1	24.1	27.8	35.4	29.3	24.5	28.8	29.3

Behavioral patterns in response to binary blends of undecanal and nonanal

The females of GWM exhibited different behavioral patterns in response to male sex pheromone that included stationary fanning, ambulation, ambulatory fanning, hovering, searching and circling. The female moths exhibit the response to pheromone during scotophase only. During photophase female GWM individuals remain in inactive position with wing held roof like and antennae extended backward. The behavior categories recorded here are similar to one reported by Romel (1991) and Fraser (1999) it was observed that initial behavior exhibited by moths was ambulation, ambulatory fanning and stationary fanning followed by hovering, searching and circling. The wing movement was also observed during hovering searching and circling behaviors, when the binary blends were tested for attractiveness to female GWM. It was observed that the moths responded during 7 pm to 3 am of scotophase. The response period of female moths to binary blend was wide. The longer response period to pheromone was also reported in several other insect include the Trichoplusia ni (Hubner) (Lepidoptera:Noctuidae) (Bjostad *et al*. 1980).

Duration of pheromone specific behavior

The duration occupied (in sec out of 300 sec) in each behavioral patterns viz., stationary fanning, ambulation, ambulatory fanning, hovering, searching and circling by the moths were compared at different exposure timing in case of 1 to 6 old female moths when exposed to the best pheromone blend. The average time span in stationary fanning behavior varied with age of the moth. Irrespective of the test-timings, the highest mean time occupied in fanning was in case of two day old moth which was 52.00 sec, followed by 49.77, 48.88, 45.44, 42.77 and 41.55 sec corresponding to 3, 1, 6, 5 and 4 day old moths, respectively (Table 2). The average time span in ambulation behavior exhibited by female wax moth varied with age of the moth. The highest mean time of 65 sec was exhibited by 5 day old moth followed by 63.88 sec, 61.66 sec, 41.88 sec, 36.55 sec and 35.11 sec with respect to 6, 4, 1, 3 and 2 day old moths respectively (Table 1). The mean time of 78.3 sec was spent in ambulatory fanning by 4 day old moths and the lowest mean response of 28.2 sec was registered in one day old moth. The lowest duration of ambulatory fanning was exhibited by 6 day old moth at 11 pm (Table 1).

The mean duration of hovering behavior was 49.7 sec, 45 sec, 42.33 sec, 35.2 sec, 33.8 sec and 25.5 sec with respect to 1 to 6 day old moths irrespective of the timings tested. The longest duration of this behavior was exhibited by 1 day old moth at 10 pm (Table 1). The average time spent by female wax moth exhibiting searching behavior varied with age of the moth. The highest time spent by day old moth was 49.66 and it occupied 38.44, 34.22, 28.44, 22.88 and 15.22 sec, corresponding to 6, 4, 3, 5, 2 day old moths, respectively (Table 2). The average time spent by female wax moth exhibiting circling behavior also varied with age of the moth. The highest time of 46.66 sec in circling behavior was exhibited by1or 2 day old moths which was followed by 34.77 sec, 26.33 sec, 22.55 sec and 8.44 sec with respect to 4, 5, 3 and 6 days old moths, respectively (Table 2).

REFERENCES

Bjostad, L.B., Gaston, L.K. and Shorey, H.H. 1980. Temporal pattern of sex pheromone release by female *Trichoplusia ni*. *J. Insect Physiol.* 26 : 493-498.

Finn, W.E. and Payne, T.L. 1977. Attraction of greater wax moth females to male-produced pheromones. *Southwestern Entomologist.* 2 (2) : 62-65.

Flint, H.M. and Merkle, J.R. 1983, Mating behaviour, sex pheromone response and radiation sterilization of the greater wax moth (Lepidoptera: Pyralidae). *J. Econ. Entomol.* 76 (3) : 467-472.

Fraser, H.W. 1997. *The effect of different conspecific male sex pheromone component ratios on the behavior of the female grater wax moth*, *Galleria mellonella* (L.) (Lepidoptera: Pyralidae). M.sc. Thesis Univ. Guleph

Hanumanthaswamy, B.C., Venkatesh, H. and Nagaraja, M.V. 2009. Influence of different species of honey bee combs on the life stages and biological parameters of greater wax moth, *Galleria mellonella* L. *Karnataka J. Agric. Sci*. 22: 670-671.

Kapil, R.P. and Sihang, R.C. 1983. Wax moth and its control. *Indian Bee J.* 45 (2/3): 47-49.

Leyrer, R.L. and Monroe, R.E. 1973. Isolation and identification of the scent of the moth, *Galleria mellonella,* and a revaluation of its sex pheromone. *J. Insect Physiol*. 19 : 2267-2271.

Nelson, R.A. and Brister, C.D. 1977. The Greater wax moth 'behavior of larvae'. *Ann. Ento. Soc. Am*. 72 : 811-813.

Romel, K.E. 1991. *The Reproductive Biology and Behaviour of the Greater Wax Moth, Galleria mellonella, (L.) and a Re-evaluation of the Male Sex Pheromone*. M.sc Thesis Univ. Guelph 103 pp.

Vanengelsdorp, D. and Meixner, M.D. 2010. A historical review of managed honey bee populations in Europe and the United States and the factors that may affect them. *J. Invert. Pathol.* 103 : S80–S95