Journal of Apicultural Research 33(3): 171–174 (1994)

Extended survival of the parasitic honey bee mite *Tropilaelaps clareae* on adult workers of *Apis mellifera* and *Apis dorsata*[1]

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(Received 28 January 1994, accepted subject to revision 4 May 1994 accepted for publication 13 June 1994)

SUMMARY

The survival of adult female *Tropilaelaps clareae* of unknown age on caged adult workers of *Apis mellifera* was investigated in ambient conditions during the rainy season in northern Thailand and in an incubator maintained at 35°C and 60% RH. Under both conditions, a small percentage of *T. clareae* survived for three days. A similar experiment using adult *T. clareae* on caged adult workers of *Apis dorsata* produced similar results: a small percentage of mites survived for three days. The observed survival of *T. clareae*, whether on *A. mellifera* or *A. dorsata*, is about one day longer than previously reported. It is now clear that the highly pestiferous *T. clareae* could easily survive even the longest of international airline flights.

Keywords: *Tropilaelaps clareae*, worker honey bees, *Apis mellifera, Apis dorsata,* parasitism, long distance transport, survival, Thailand

[1]All editorial functions for this paper, including the selection of referees, have been undertaken by staff at IBRA headquarters

INTRODUCTION

Tropilaelaps clareae is a parasite of *Apis dorsata*. The natural range of *T. clareae* is therefore thought to be limited to the range of *A. dorsata*, principally SE Asia and the Indian subcontinent. However, the mite also readily infests colonies of the western honey bee, *A. mellifera*, introduced into Asia for its desirable apicultural characteristics. In SE Asia the mite has proved to be a more serious pest of *A. mellifera* than *Varroa jacobsoni*, a mite which has similarly expanded its host range to *A. mellifera* from another Asian honey bee species, *A. cerana*. Colonies of *A. mellifera* kept in areas where *T. clareae* is present need continual prophylactic treatment with acaricides to prevent their loss from this mite. Unchecked, *T. clareae* will rapidly cause the death of colonies.

Since most transport of honey bees is done via air mail using mated queens attended by adult workers, the potential for *T. clareae* to be accidentally introduced to countries where it is not yet present depends principally on whether or not it can survive on adult bees. Woyke (1984) found that *T. clareae* could survive 'for 1–2 days only' on adult *A. mellifera* workers and Koeniger and Muzaffar (1988) found that the last of 60 mites died 25 h after being placed with adult *A. mellifera* and, the last of 60 mites died 57 h after being placed with adult *A. dorsata*. These experiments were conducted under ambient conditions in Afghanistan and Pakistan, respectively, and low humidity may have influenced the results.

MATERIALS AND METHODS

We studied the survival of adult female *T. clareae* on adult workers of *A. mellifera* and *A. dorsata* in Chiang Mai, Thailand, during the rainy season in October, 1993. The experiments were conducted in ambient conditions in an outdoor shelter in which temperatures ranged from 27°C to 29°C and relative humidities (RH) ranged from 50% to 70%. Incubator studies were done in November in Bangkok, Thailand, using workers of *A. mellifera*. Incubators were kept dark and were maintained at 35°C and 60% RH.

Ambient conditions

Four cages of *A. mellifera* were established, each comprising 10 newly emerged workers, 20 randomly aged workers and 10 adult female *T. clareae* of unknown age. Cages were constructed from 1.5 litre plastic water bottles, having the top portion removed and covered with a board having screened areas to hold feeders. Adult mites of unknown ages were collected from the brood combs of infested *A. mellifera* colonies. Each cage was supplied with a feeder containing 50% sucrose solution, a feeder containing water, and for two of the four cages, 3 × 8 cm sections of dry *A. mellifera* comb. The following day all cages were dismantled and bees, cages and comb were examined for mite survival. Mites were counted and determined to be dead or alive based on motility. No detectable differences in mite survival were found between cages with and without comb ($\chi^2 = 0.95$, d.f. = 1, P = not significant). However, all subsequent cages established were given comb to facilitate the removal of bees from the cages during examinations for mites.

The mites that survived the first day were placed into a separate cage containing 10 newly emerged workers and 20 randomly aged workers of *A. mellifera*.

Fourteen cages were then prepared with *A. mellifera* workers as before, except that 15 adult female *T. clareae* were introduced into the cages. These cages were examined for mite survival after three days.

Adult *A. dorsata* were collected by attracting foraging bees into cages baited with a small amount of diluted honey. Approximately 30 bees were collected in each of six cages. Twenty mites were introduced into four of the cages, while the remaining two cages each received 15 mites. Cages were supplied with 50% sucrose solution, water and *A. mellifera* comb. The four cages with 20 mites each were inspected after two days. The two cages with 15 mites each were inspected after three days.

Incubator conditions

Using similar cages and techniques, 12 cages were stocked with 30 adult worker *A. mellifera* and 15 adult female *T. clareae*. Four cages were each inspected for mite survival after one day. From these four cages, 19 mites were found alive and these were placed into a separate cage containing 30 randomly aged workers of *A. mellifera*. This additional cage and four of the eight remaining original cages were inspected on the second day. Six mites were found alive and were placed into a separate cage containing 30 randomly aged workers of *A. mellifera*. This additional cage and the four remaining original cages were inspected for mite survival on the third day. One mite remained alive in these cages.

In all experiments, test bees, combs and cages were individually examined for mites. The position of living mites on bee hosts was noted and recorded.

RESULTS

Ambient conditions

Sixteen of the 40 mites survived with *A. mellifera* through the first day (table 1). Two of the 16 mites survived through the second day (table 1). Two of 210 mites introduced into the 14 cages on day 0 remained alive after three days (table 1).

TABLE 1. Survival of adult *Tropilaelaps clareae* on adult workers of *Apis mellifera* and *Apis dorsata*.

	Examination time		
	After 1 day	After 2 days	After 3 days
Apis mellifera			
Ambient conditions			
dead mites	22	9	80
living mites	16	2	2
not recovered	2	5	128
number of cages	4	1	14[1]
Incubator conditions			
dead mites	36	57	50
living mites	19	6	1
not recovered	5	16	15
number of cages	4	5	5
Apis dorsata			
dead mites	NA	7	17
living mites	NA	11	2
not recovered	NA	62	11
number of cages	NA	4	2

NA = no data collected for day one survival of mites on *A. dorsata*
[1]These cages were different ones from those examined after 1 and 2 days

Of 80 adult *T. clareae* placed with adult *A. dorsata*, 11 remained alive after two days. Two of 30 mites remained alive after three days (table 1).

Incubator conditions

Incubator experiments using *A. mellifera* gave similar results to those obtained during the experiments done in ambient conditions. Nineteen of 60 mites were found alive after one day, six of 79 mites were found alive after two days, and one of 66 mites was found alive after three days (table 1).

DISCUSSION

Overall, of the 59 mites found alive on honey bees after 1, 2 or 3 days, 44 of them were each found individually on the thorax of a living bee, just below the scutellum, with its ventral surface nearest the bee, its head directed toward the ventral surface of the bee and its legs grasping firmly to bee hairs in the area. This observation accords with that of Buchler *et al.* (1992) who found about seven of 14 *T. clareae* in the 'petiolous region' of adult *A. dorsata* shortly after they were placed on the honey bees. There were four mites separately observed on the ventral surface of the thorax of a living bee between the bases of the legs grasping the hairs, three observed on a dorsolateral thorax, three on the anterior dorsal gaster, two on the lateral surface of the thorax near the wing base, two on the ventral dorsal gaster, and one mite was found running free on an *A. dorsata* worker. In no case was more than one mite found on a bee.

In many cases, mites were not recovered. They may have deteriorated beyond recognition in the humid cages, been eaten by the bees or simply gone undetected in the cells of the comb. If they had survived, their movement on the comb should have made them obvious. Dead mites often showed damage suggesting that they had been bitten by bees in cages of both *A. mellifera* and *A. dorsata* as has been previously reported for *A. cerana* and *A. dorsata* (Wongsiri *et al.*, 1989). Rapid deterioration of mites in the humid cages made determinations of the frequency of damage to mites from grooming imprecise.

The uniform positions of living *T. clareae* and their solitary dispersal among the hosts suggest adaptive behaviour. Probably the sub-scutellum and ventral thorax areas are places where individual bee actions and grooming behaviour (Buchler *et al.*, 1992) are less likely to dislodge or damage a mite. Clearly, *T. clareae* is adapted to spend some time on adult honey bees. Perhaps some mechanisms exist to cause mites to attach to foraging bees in these locations which permits them to shift to bees from different colonies at foraging sites. Perhaps some mechanisms cause physiological changes in *T. clareae* which permits adherence to migrating *A. dorsata* and survival across the long periods required for such migrations (Ruttner, 1987).

The survival of mites in our study, whether on *A. mellifera* or *A. dorsata*, is about one day longer than previously reported. Perhaps different, less artificial conditions will support still longer periods of survival. Certainly, this study has several artificial conditions

such as disturbance during a mechanical transfer to new hosts, hosts held in small cages etc., which could shorten the survival of the mites. These concerns preclude any recommendation concerning times or conditions to destroy all *T. clareae* on caged honey bees in all cases. However, in any event, it is now clear that the highly pestiferous *T. clareae* could easily survive even the longest of international airline flights. The recent report of their discovery in Africa (Kumar *et al.*, 1993) suggests that such an event has already occurred.

ACKNOWLEDGMENTS

We thank Sumluck Wongsamanode, Surachai Leephitakrat, and Prapoth Juprachakorn for assistance; the Australian Research Council for funding to BPO; USAID for funding the local travel of Thai investigators, and the Research Affairs Division, Chulalongkorn University for the use of Bee Biology Research Unit facilities. In co-operation with Louisiana Agricultural Experiment Station.

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