The Effect of Honey Bee Tracheal Mite Infestation on Colony Development and Honey Yield of Buckfast and Italian Honey Bee Strains in Israel

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Abstract

Infestations by honey bee tracheal mite, Acarapis woodi (Rennie) (HBTM), were followed in three groups for one year. The groups consisted of 1) scabicide (amitraz) treated Italian bee colonies, 2) untreated Italian bee colonies, and 3) untreated Buckfast colonies. Mite prevalence of Buckfast bees declined from 45% in December to 10% in April and remained low, and most queens persisted for the entire period. Furthermore, bee populations increased and honey yield was high in comparison to seasonal averages. HBTM prevalence in the treated Italian colonies remained low until July, with a large increase in bee populations and honey yield, similar to that of the Buckfast colonies; however only a quarter of the queens survived. The untreated colonies were severely infested by the mite and much reduced in population, produced little honey and most of their queens were replaced. Nosema infections and Varroa mite prevalence rates were similar in all treatments. Along with a documentation of HBTM damage and control, this is also the first demonstration of the resistance of Buckfast bees to A. woodi under Mediterranean conditions.

INTRODUCTION

The honey bee tracheal mite, Acarapis woodi (Rennie) (HBTM) was recently found in Israel (Gerson et al, 1994). Our preliminary observations indicated that the mite causes considerable damage, as it does in North America (Eischen et al., 1989), but in contrast to results obtained in Europe (Bailey and Lee, 1959). Numbers of honey bee colonies decreased because of increased bee mortality, especially in winter and spring, and honey production was much reduced. An intensive control project initiated at that time showed that fumigation with the pesticide amitraz could control the pest (Dag et al., 1997).

Honey bees show a wide range of susceptibilities to HBTM infestations, and vulnerable as well as resistant strains can be selected under controlled breeding conditions (Page and Gary, 1990). 'Buckfast' strain of honey bees has been undergoing selection since 1917 in England, and is credited with possessing a comparatively elevated level of resistance to HBTM without affecting bee productivity (Brother Adam, 1987; Lin et al, 1996).

The aims of the present study were to quantify the rate of HBTM infestation and damage to a local Italian strain and to the Buckfast strain.

MATERIALS AND METHODS

An apiary containing 30 colonies, all heavily infested with HBTM, was established near Bet Dagan (coastal plain) in December 1996. The colonies were divided into three treatment groups of equal adult populations (5.5 populated frames). Colonies were provided either with Italian queens ('Zrifin, Central Breeding Apiary', n=20) or with Buckfast queens ['Paz Breeding Apiary', originating from a Buckfast breeding apiary in Luxembourg (stock B182), n=10]. Ten of the Italian colonies were fumigated three times with amitraz (for methodology, see Dag et al., 1997) in early December, before introducing the queens, whereas all other colonies were left untreated. All queens were mated naturally in an isolated area with drones from same-strain colonies. All queens were marked by clipping one of their wings and with painting their dorsal thoraces.

Samples of ca 200 bees were collected from the outer populated combs of these colonies at monthly intervals; two samples were taken during the spring months (March-April). Collected bees were kept at -18°C until examined. The thoraces of 35 bees in each subset were dissected, their thoracic disks cleared in 2M NaOH (Shimanuki and Knox, 1991) and examined for tracheal mites. Results were calculated as rates of infested bees per colony on each sampling date.

Adult bee populations were collected monthly and colonies were carefully examined for brood disease. Honey yield was recorded during the spring and summer harvests. The colonies were examined for the presence of the original queens in December 1997, a year after the trial was started. In order to reduce the effects of other common bee pests, all colonies were...
treated with Apistan® against *Varroa jacobsoni* and with Fumidil-B® against *Nosema apis*, according to the manufacturers’ instructions. In addition, 20 bees/sample were examined for *N. apis* (Shimanuki and Knox, 1991).

Differences within treatments were analyzed by a hive-nested two-way ANOVA. Tukey’s Test was used for comparisons of data obtained on each date.

**RESULTS**

Tracheal mite prevalence

The prevalence level in the Buckfast colonies decreased rapidly from around 43% (e.g. similar to that of the untreated Italian colonies) in December 1996 to ca 10% in April 1997 and stayed low (Fig. 1). In the untreated Italian colonies prevalence rates remained high and steady, at about 50%, until March and then began to decline, probably due to the death of the most infested colonies. In the treated Italian colonies prevalence rates stayed low, under 10%, until July, and then began to increase.

Adult population

The initial adult population of the three groups was quite similar. The treated Italian colonies built-up rapidly in the spring, to about 20 combs of bees, but the untreated populations had only 10 combs. Buckfast colonies had a maximum of 15 combs of bees in the spring (Fig. 2).

Honey yield

No honey could be harvested in spring or summer from 9 out of the 11 untreated Italian colonies; their average spring yield was 1.0 kg (for all colonies) and 2.0 kg. in summer (Fig. 3). In the spring the treated Italian colonies produced an average of 21.9 kg., significantly more (p<0.05) than the untreated Buckfast colonies (10.4 kg.). Buckfast colonies produced significantly more honey in the summer than the treated Italian colonies (9.6 vs 5.4 kg., p<0.05). The total annual yields were statistically different.

Survival of Queens and colonies

Survival of queens appeared to be more affected by the type of the queens than by the treatments. In the untreated Italian colonies only one out of the five colonies that survived at the end of the year still carried the original queen, as did two out of the nine surviving treated Italian colonies. Conversely, eight out of nine surviving original Buckfast queens remained at the end of the year.

Brood disease, nosema infection and Varroa mite infestation

Casual observations showed that chalkbrood mummies occurred only in the weakened untreated Italian colonies, prior to colony collapse. No to negligible nosema infection occurred in all bee groups through the experimental period. *Varroa* mites were seen neither in any colonies nor on adult bees.

**DISCUSSION**

The recommended amitraz applications successfully controlled HBTM for at least six months (Fig. 1). The untreated Italian colonies suffered heavily, as high mite infestations significantly reduced colony populations (Fig. 2), honey yield (Fig. 3) and increased colony mortality. This is in contrast to other reports from our region (Orantes et al., 1997; Mossadegh and Bahreini, 1994). High mortality of colonies heavily infested by HBTM is well documented in temperate regions (Badly and Ball, 1991; Otis and Scott Dupree, 1992), especially in bees of susceptible strains (Danka et al., 1995).

Danka et al. (1995), reported from the central U.S.A. that HBTM infestation of Buckfast bees remained relatively low during one year, whereas it increased in a susceptible strain. Frazier et al. (1995) reported somewhat similar results: infestations of susceptible Italian colonies in the northeastern U.S. increased to 55% during 9 months, but only to 40% in Buckfast bees. The high levels of HBTM damage which we found called for exploring non-chemical modes of control, beginning with the present assay of Buckfast bees. The present report is thus the first to demonstrate the resistance of Buckfast bees to HBTM infestations under...
Fig. 2: Average adult bee populations in untreated Italian colonies, untreated Buckfast colonies and in treated (with amitraz) Italian colonies, Bet Dagan, 1996-7. Values joined by an arrow differ from each other at the 0.95% level.

Fig. 3: Average spring, summer and total honey yields, in treated (with amitraz) and untreated Italian colonies and in untreated Buckfast colonies, Bet Dagan, 1996-7.

Mediterranean conditions. The resistance of this strain is due chiefly to a lower infestation rate among bees in a colony, as compared with susceptible bees (Danka and Villa, 1996). The differences between our and the North American results may have been due to our initial high infestation levels (around 50%), as compared to less than 10% in the U.S. Another possibility is that the Buckfast strain is not homogenous, and that different genetic stocks were tested in each of the U.S. experiments.

We believe that under Israeli conditions, use of resistant bees, such as the Buckfast strain could be a viable alternative to chemi-

March 2000
cal treatments against HBTM. Resistance of the local Italian colonies to HBTM might be achieved by closed population breeding, as done in the U.S. with Carniolian bees (Cobey, 1997).

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LITERATURE CITED