Abstract

Pollen traps, in conjunction with walnut leaf smoke or mint leaves, were tested as a control for Varroa destructor. Experimental colonies were left untreated for one year prior to use in this study. Four treatment groups were tested: I - walnut smoke+pollen trap, II - paper smoke+pollen trap, III - walnut smoke only, and IV - mint leaves+pollen trap. Group V remained with no treatment. Both treatment and time were significant factors in the reduction of mites, as was the interaction effect (treatment x time). Although all treatments with pollen traps reduced mite population by approximately 50%, the treatment without pollen trap reduced mite population significantly more.

Key words: Apis mellifera, Varroa destructor, pollen trap, walnut smoke, mint leaves.

Varroa destructor continues to be an important parasite of the honeybee (Apis mellifera) in Europe, despite two decades of research aimed at controlling this pest. This is also true in Turkey where the Korean haplotype of V. destructor occurs (18). Unfortunately, V. destructor in a number of countries it has gained a resistance to the commonly used acaracides (e.g. fluvinate and coumaphos), which were initially very effective (5, 12, 16). In addition to the problem with varroa’s resistance to fluvinate and coumaphos, there is increasing concern about chemical pesticide residues in honey after mite treatment, and from other sources (1, 11), e.g. European Union regulations 2377/90 and 434/97.

Essential oils such as thymol, menthol, and camphor have been studied as alternative agents for mite control. They leave no significant residues in honey or wax (9, 10). While they have been shown to be effective agents for the control of tracheal mites (e.g. citronannal oil treatment eliminates about 67% of tracheal mites), their effectiveness in controlling varroa is still questioned (6, 14). In a similar way, smoke from burning walnut and other plants, has produced mixed success in increasing varroa reduction (2, 4). Beekeepers in Turkey have begun trying different alternative varroa treatments (e.g. tobacco, cedar, thyme, pine, pyrethrum), in the hope of reducing both costs and pesticide residues (17).

Although not effective in controlling varroa by itself, bottom screens or screen floors are considered an important part of varroa integrated pest management strategy, since they slow down varroa population growth (3, 8). According to this, we wondered whether full bottom pollen traps in conjunction with either walnut leaf smoke or mint leaves might be effective in controlling varroa. In addition to smoke or mint induced mite reduction, mites may be scraped off from bees returning to the hive when smoke is applied, or mint odour is added. The pollen trap also presents an easy mechanism for monitoring the mite’s reduction so that beekeepers can decide when chemical acaricide treatment is needed. Here we present data on a test of this idea.

Material and Methods

The experiments were performed using Anatolian bees (13) in October and November 2004. Colonies used in the experiment were full depth, 10 frame, Langstroth hives, and were kept at the experimental site, without any mite treatment for one year in advance of the test. All the colonies were re-queenied with sister queens in August 2004, at which time they were also manipulated so that each had 7 frames of bees, and a brood area with a 10 to 15 cm radius. The colonies were randomly divided into 5 groups of 9 colonies each, and randomly assigned to treatments. Group I colonies received smoke from burning semi-dry walnut leaves (Juglans regia), and each hive had a full bottom-board pollen trap. Group II
colonies received smoke from burning paper (cardboard), and each hive had a full bottom-board pollen trap. Group III colonies received only smoke from burning walnut leaves and did not have pollen trap. Group IV had a full bottom-board pollen trap containing fresh mint leaves (*Mentha aquatica*) in the drawer. Group V did not receive either smoke or mint treatment. Groups II, III, and V served as controls: group II for the effects of smoke of any sort, group III for the effect of pollen trap, and group V provided data on mite numbers with no treatment.

The experiment was initiated in October, by sampling each hive (groups I to IV) for mites. About 200 bees from the brood area were captured and placed in a jar with ether. The jar was shaken by hand, following the method of Shimanuki and Knox (15). Treatments were subsequently applied every 3 d (i.e. smoke for groups I, II and III, and fresh mint leaves for group IV), eight times (days 3, 6, 9, 12, 15, 18, 21, and 24). Mites were counted every 3 d from pollen drawers in groups II, IV, and I, and from a tray with powder placed above the bottom board on the sampling day for group III. At the end of the study (day 27), mites were again sampled from each hive (groups I to IV), by taking about 200 bees from the brood area and placing them in a jar with ether. Flumethrin strips were applied to all colonies at the end of the experiment (groups I to V) to find out number of remaining mites.

The varroa reduction in groups I to IV was analysed for differences both among treatments and concerning the sampling period, using a repeated measures MANOVA (treatment, time, treatment x time). Difference among treatments (groups I to IV) in pre/post-experiment varroa numbers from the jar-ether method (groups I to IV), was tested in each case using an ANOVA. Changes in varroa between pre/post-experiment jar-ether samples, was analysed using a paired-score t-test. ANOVA was used to test the differences among groups using post-experiment mite numbers, obtained by using flumethrin strips.

Results

Eight colonies died between August and the end of the experiment in November, none from group I (walnut-smoke plus pollen trap), 1 from group II (paper-smoke plus trap), 2 from group III (walnut-smoke), 3 from group IV (mint plus trap), and 2 from group V (no treatment). Only data from colonies that survived the whole period were analysed. The pre-experiment (day 0) varroa reduction, based on the jar-ether method (groups I to IV), did not differ significantly among treatments ($F=1.260$, $df=3,26$, $P=0.309$). Both treatment ($F=6.61$, $df=3,26$, $P=0.0018$) and time ($F=4.20$, $df=7,20$, $P=0.0053$) were significant factors in mite reduction. There was also a significant ($F=1.78$, $df=21,58$, $P=0.044$) interaction effect (treatment x time). The mite reduction peaked between days 9 and 12, and depended upon the treatment, with the highest peak observed for group III (paper-smoke with pollen-trap) treatment (Fig. 1).

The post-experiment (day 27) number of varroa based on the jar-ether method (groups I to IV), did not differ significantly among treatments ($F=0.98$, $df=3,26$, $P=0.417$). However, there was an overall decline in mite count, between pre/post-experiment jar-ether samples (mean+standard error: $22.7\pm1.9$ to $15\pm1.24$; paired-score $t$-test: $t=4.08$, $df=29$, $P=0.0003$). Flumethrin determined mite-count per colony (Fig. 2) differed significantly among the 5 groups ($F=4.20$; $df=4,32$; $P=0.0076$).

Discussion

All manipulations (groups I to IV) significantly reduced mite populations in comparison to non-treated (group V) colonies. Although the jar-ether method suggested that there was no difference in post-experiment average mite population levels, among the 4 treatment groups (I to IV), flumethrin treatment showed that the group subjected to walnut-smoke with no pollen
trap (group III), actually had a significantly lower average mite count. Post-experiment average mite count was about half of that of colonies non-treated with a pollen trap (groups I, II & IV); and in the case of group III, it was about a quarter of the non-treated colonies which surprised us.

Mite reduction during treatments of groups I to IV varied among groups; and over time, all 3 treatments with pollen traps had similar initial (days 3–9) and final (days 18–24) mite reductions. Although the varroa reduction using paper-smoke with pollen trap peaked much higher than the other treatments, this peak was not reflected in a final lower average mite level. This peak also was not observed in an earlier study of the effect of walnut-smoke application on mite reduction (2). The mite reduction in the group without pollen trap (III) was lower than in the other groups. This was not totally unexpected; since pollen traps collected mites continuously over the entire 3 d between treatment periods, whereas the powder-sugar tray only collected mites on the day after treatment (humidity made the method non-effective after a day). However, mite reduction recorded from pollen traps was more than three times of that observed in the group without pollen traps. This suggests that the effect of colony treatment is not immediate, whether it is walnut-smoke, paper-smoke or mint leaves.

Several species of plant leaves (e.g. walnut, tobacco) have been used to produce smoke in tests for an anti-varroa agent. Laboratory studies have reported smoke from burning some of these leaves to knockdown 70% to 90% of the exposed mites (4, 7). However, lab tests have not always been good predictors of field test (6). Environmental factors and beekeeping practices, are 70% to 90% of the exposed mites (4, 7). However, lab tests have not always been good predictors of field test (6). Environmental factors and beekeeping practices, are thought to lead to these differences. This may be the reason why we did not see higher mite reductions, with walnut-leaf smoke or mint leaves over simple paper-smoke in the pollen trap treatments.

Although pollen traps did not have a negative effect on the brood production or on honey consumption by the colony, as long as half of the incoming pollen was allowed to enter to a colony in the Bursa province of Turkey (unpublished data), and they were not as effective in reducing varroa populations as treatment without pollen traps. We expected the opposite result, since pollen traps could help dislodge the mites, as bees pass in and out of the hive (especially in response to smoke treatment). Further investigation is needed to explain these results.

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References