

ERADICATING VARROA MITES (*VARROA DESTRUCTOR*) BY SPRAYING CLOVE TEA

Abstract

This study is a field experiment of using clove tea as an effective treatment against varroa mites (*Varroa destructor*), by spraying the tea directly on all the frames in the beehive. Two experiments were conducted, one for 14 weeks, with an application of clove tea once every 2 weeks and the other for 8 weeks with an application once per week. In both experiments after 6 applications, the tea-treated varroa-infected beehives were completely varroa-free, concluding complete eradication.

Keywords: *clove tea, Varroa mites, Varroa destructor, honey bee, organic bee treatment.*

INTRODUCTION

Varroa mites (*Varroa destructor*) are parasites that affect the honey bee (*Apis mellifera*), which causes great damage to bee colonies. Synthetic miticides have been used to control varroa infestations. However, some problems arise from the use of such synthetic chemicals. The usage of synthetic miticides creates mites resistant to the chemicals (Rodriguez-Dehaibes et al., 2005), and it contaminates honey, propolis, and wax (Ruffinengo et al. 2002). In addition, bee queen exposure to synthetic miticides during development negatively affects the queen's reproductive health (Rangel & Tarpy 2015). Another study has also found that synthetic acaricide exposure affects bee grooming, the natural removal of mites by the bees scraping them off, it delayed and reduced the overall duration of grooming behavior (De Matos et al., 2017).

An alternative treatment of varroa by using organic compounds is becoming attractive for beekeepers. Essential oils have proven to be effective and safe in treating bee colonies for varroa mites (Skinner et al., 2001), even if the essential oils are administered orally by adding them to the sugar feed are still safe for the bees in the right doses (Ebert et al. 2007).

A study shows that the treatment of bee hives by the method of cotton soaked in clove essential oil had a significant effect on the average mortality of varroa mites (Kadhim et al. 2021). One study showed that clove oil causes a 60% mortality rate in *V. destructor* mites at a dosage of 1.0 μ l for 48 hours (Li et al., 2017). Another study indicates that clove oil has an effect of 96% mite mortality on varroa mites with topical applications of eight dilutions of 0.75 mg/vial (Gashout & Guzman-Novoa 2009). Also, a residue of clove oil after treatment was discovered in beeswax during a two-week period under semi-field conditions, which indicates a long-term effect of the oil (Girisgin et al., 2014). Essential oil fumigation and evaporation treatment can effectively control mites in adult bees, but it cannot penetrate the cell capping, therefore it does not control mites in brood cells.

All these above-mentioned studies focus on using essential oils as fumigants or for evaporation. Essential oils do not mix in water; therefore, no consistent and measurable direct spraying method could be applied because the concentration of oil ejected by the sprayer will be random. Moreover, essential oils are usually more expensive than commercial synthetic miticides. Thus, using clove essential oil is not easily applicable in a consistent matter with a spraying method. However, clove flower buds are relatively inexpensive and easily available, and making clove tea for spraying application is a simple and approachable method for the common beekeeper.

MATERIAL AND METHODS

40 grams of clove buds (*Syzgium Aromaticum*) were placed in 4 liters of hot water and kept covered with a lid until the solution cooled down. The solution (tea) was filtered and poured into a spray bottle. Whole cloves were used to make the solutions because crushed or powdered cloves tended to clog the spray head, caused by residue in the solution.

Field Experiment 1.

One first initial field experiment was done in the Municipality of Makedonski Brod in Macedonia on 12 honey bee colonies in a Langstroth 10 frames hives (one box/floor) of *Apis melisa Macedonica*: 6 varroa infested, 6 non-infested. All six groups were placed in six different locations in the Municipality, at least 15 km apart. Brood was present in the hives with 4 to 5 frames.

Group one - varroa infested, treated with cloves tea.

Group two - varroa infested, treated with water (placebo)

Group three - non-infested, treated with cloves tea.

Group four - non-infested, treated with water (placebo).

Group five - non-infested, control group not treated with anything.

Group six - varroa infested, control group not treated with anything.

The application was done by individually splashing each frame of the hive with the solution (mist) on both sides, applying 4 applications (splashes) per side. The treatment was done in the late afternoon, to allow for more bees to be home in the hive while applying the treatment. The application and inspection were done once every two weeks with a total period of 14 weeks, 8 applications in total. The experiment started on the 1st of March 2023 and ended on the 7th of June 2023.

Anti-varroa floor- Screen bottom board was used in the hives. Anti-varroa floor is a modified bottom board with a screen to allow mites to fall to a metal board or on the grass below the hive. The fallen dead mites on the metal board were counted to calculate mortality. Dead bees' mortality is impossible to accurately count in the field because bees clean the hive and take out the dead bees outside the hive.

Field Experiment 2.

A second larger scale field experiment was conducted in the Municipality of Makedonski Brod in Macedonia starting from the 21th of June, until 16th of August for a total of 8 weeks.

18 honey bee colonies in a Langstroth 10 frames hives (one box/floor) of *Apis melisa Macedonica*: The two groups were placed in two different locations in the Municipality, at 40 km apart. Brood was present in the hives with 4 to 5 frames.

Group one – 9 hives of varroa infested, treated with clove tea.

Group two – 9 hives of varroa infested control group, not treated with anything.

The methodology and other parameters were the same as the first initial experiment, except that the clove tea was applied once per week over a period of 8 weeks. Any sprayed solution (even distilled water) may cause some varroa mites to dislodge from the bees (Elzen et al. 2001). After spraying the water (placebo) it dislodged a small number of the mites from the bees, but it did not kill them. However, in the case of the clove tea, after applying it to the bees, direct contact made mites dislodge from the bees, significantly more than the water placebo, and directly kill and immobilize the mites within 10-25 minutes. Clove tea-treated hives did not experience any evident decrease in bee population or diminished overall bee health.

RESULTS AND DISCUSSION

Field experiment 1

The mite-infested (Group 1) after treatment, Hive 1.1. increased its bee population, it had 6 frames nested with bees at the beginning of the experiment and in week 10 it had 10 frames nested with bees, and hive 1.2. from 7 frames full of bees to 9 frames full of bees. In addition, a calming effect on the bees was observed after the application of the clove tea, and a significant reduction in speed of movement and reduced irritability was noted. The complete results list of dead mites from the treatment with clove tea are shown in table 1.

Table 1. Number of varroa mites dead after treatment, first experiment.

Group	Week 0	Week 2	Week 4	Week 6	Week 8	Week 10	Week 12	Week 14
H. 1.1	506	190	50	10	2	1	0	0
H. 1.2	600	252	66	37	5	0	0	0
H. 2.1	5	4	10	20	19	32	27	30
H. 2.2	3	6	12	15	22	37	40	47
H. 3.1	0	0	0	0	0	2	0	0
H. 3.2	0	0	0	0	0	0	0	0
H. 4.1	0	0	0	0	0	2	1	5
H. 4.2	0	0	0	0	0	0	0	0
H. 5.1	0	0	0	0	0	0	0	0
H. 5.2	0	0	0	0	0	0	0	0
H. 6.1	11	9	15	25	42	30	39	48
H. 6.2	8	11	7	21	36	47	35	51

Group one - varroa infested, treated with cloves tea. Hive 1.1. After the first application, an estimated 50% of the mites in the hive were eradicated. After 10 weeks and 6 treatments, all signs of Varroa mites vanished in the hive. Hive 1.2. In the first application an estimated 60% of the mites in the hive were eradicated, after 8 weeks all signs of varroa disappeared in the hive.

Group two - varroa infested, treated with water (placebo). In Hive.2.1. and Hive2.2. The number of Varroa mites found dead gradually increased, but that is because the overall live mites population increased in the hive, and most of the deaths are from other causes, not the water treatment.

Group three - non-infested, treated with clove tea. Hive 3.1. No mites were present at the beginning of the experiment. However, in week 10 and week 12, a few dead mites were accounted for. This is assumed that some bees got the infestation from outside the hive. In weeks 12 and 14 there were no dead or live mites in the hive, complete eradication of the newly appeared infestation was achieved. Hive 3.2. No varroa presence was noted during the study period.

Group four - non-infested, treated with water (placebo). Hive 4.1. At week 10, this colony developed varroa infestation, with an increase in counted dead mites as a result of increased overall mite presence in the hive. Hive 4.2. No varroa presence was noted during the study period.

Group five - non-infested, control hives not treated with anything. No mites dead or alive were observed during the experiment.

Group six - varroa infested, control hives not treated with anything. The hives had a gradual increase of counted dead mites due to an expanded overall varroa infestation.

Field experiment 2

Clove tea had the same effect on varroa mites as in the first experiment. Achieving complete eradication of all varroa mites in the treated hives after 6 applications, with no varroa presence by week 7 (Group H 1. 1-9). Two of the treated hives achieved complete varroa eradication by week 6 (5 applications). At the beginning of the Experiment all the hives had 7-9 frames nested with bees. After 4 weeks all clove tea treated hives had 10 frames nested with bees.

In the control group, the hives had a gradual increase of counted dead mites due to an expanded overall varroa infestation (Group H 2. 1-9). Bee population reduced in the control group to 6-7 frames nested with bees by week 8. The complete results list of dead mites from the treatment with clove tea are shown in table 2.

Table 2. Number of varroa mites dead after treatment, second experiment.

Group	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
H 1.1	581	129	49	19	5	1	0	0
H 1.2	650	150	40	11	2	0	0	0
H 1.3	470	190	60	20	7	2	0	0
H 1.4	510	202	51	17	3	1	0	0
H 1.5	490	120	20	11	9	5	0	0
H 1.6	610	131	59	13	8	2	0	0
H 1.7	548	180	66	29	11	4	0	0
H 1.8	628	93	39	10	3	0	0	0
H 1.9	575	102	50	21	9	2	0	0
H 2.1	6	12	10	19	24	30	29	32
H 2.2	8	10	14	11	16	15	21	24
H 2.3	5	4	11	10	9	23	20	19
H 2.4	3	9	18	20	19	24	31	35
H 2.5	9	15	12	31	29	31	27	41
H 2.6	12	21	15	19	25	30	31	37
H 2.7	5	11	14	21	19	23	20	26
H 2.8	7	12	21	25	31	36	43	46
H 2.9	9	17	29	18	35	34	41	40

Discussions

This experiment of spraying clove tea shows a potential organic approach to completely eradicating varroa mites' presence in bee hives. Clove residues in the honey are unavoidable after so many treatments. However, according to the World Health Organization clove residues in food pose no danger to consumers. Therefore, honey with clove residue is safe for consumption. It can be argued that it is even beneficial for the consumer, because of clove's health benefits to the human body (Parle & Khanna, 2010). The method is labour intensive, requiring individual application on all frames in the hive, as opposed to placing one soaked cloth in essential oil for evaporation within the hive. However, the results were much more effective with this clove tea spraying method because it completely eradicated the *Varroa* mites after 6 applications in the treated hives. In addition, clove buds' tea is far less expensive than clove oil, it is also easily obtained and available in common groceries.

CONCLUDING REMARKS

This study indicates that spraying clove tea on bee hive frames is effective in eradicating varroa in infested bee hives. However, the study has several weaknesses that need further investigations. Additional studies are required for the long-term effects on honey contamination, larvae health, queen reproductive capacity, etc. This experiment focused only on the mortality rate of varroa mites by spraying clove tea. This experiment shows that clove tea eradicates/kill varroa mites. Future studies can prove at what cost does it that, and if there are any side effects or other health issues to the bee colonies by its application.

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ИСКОРЕНУВАЊЕ НА ВАРРОА КРЛЕЖ (*VARROA DESTRUCTOR*) СО ПРСКАЊЕ НА ЧАЈ ОД КАРАНФИЛЧЕ

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Апстракт

Оваа студија е теренски експеримент со користење на чај од каранфилче како ефикасен третман против вароа крлеж (*Varroa destructor*), со директно прскање со чајот на сите рамки во кошниците со пчели. Беа спроведени два експерименти, еден за 14 недели, со нанесување на чај од каранфилче еднаш на секои 2 недели, а другиот за 8 недели со нанесување еднаш неделно. Во двата експерименти веќе по шестата апликација од третманите заразениите пчелни семејства третирани со чај беа целосно без варола, заклучувајќи целосно искоренување.

Клучни зборови: чај од каранфилче, вароа крлеж, вароа деструктор, медоносна пчела, органски третман на пчели.

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