

***Varroa destructor* REMOVAL EFFICIENCY USING BEEVITAL HIVE CLEAN PREPARATION**

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S u m m a r y

The efficacy of the removal of *Varroa destructor* mites with the use of the ecological preparation Beevital Hive Clean (Austria) was determined in 10 colonies after triple application every seven days from September to October in 2008. Mite fall in each colony was monitored for 3 weeks in consecutive day-periods after preparation application. Number of bees per colony as well as number of mites per 100 bees were estimated in November. Based on the number of mites which remained in the colonies for wintering, the efficacy of Beevital Hive Clean was calculated to be on the average of 91.6% (from 85.3 to 100.0% in single colonies).

Keywords: *Varroa destructor*, honey bee, Beevital Hive Clean, preparation efficiency.

INTRODUCTION

Varroa destructor is the main threat to honey bee survival on a world-wide scale. Control treatments of this mite are based on the use of acaricides, produced in specialised laboratories as well as on substances of natural origin (Calderone and Spivak, 1997; Sammaturo et al., 1998). It is suggested that an acceptable level of varrocidal efficacy for chemical preparations should not be less than 95% since there is no totally effective treatment for varroa (Sas et al., 2008).

The repeated use of synthetics as varroacides results in the development of resistance in the varroa mites to the product. Varroa population resistant to amitraz was found in the end of XX century (Elzen et al., 1999) and mite resistance has been reported for almost all chemical substances used (Pohorecka and Bober, 2007; Spreafico et al., 2001; Thompson et al., 2002).

There is current concern about contamination of bee products with synthetic substances against the Varroa.

Substances to control mites which are milder in action but more natural in origin are finding their place in common apiculture practice. Organic acids alone, volatile oils from herbs and combinations like Beevital Hive Clean (Austria) are traded nowadays for this purpose.

The aim of this study was to evaluate the efficacy of the Beevital Hive Clean (Austria) preparation in removing *Varroa destructor* mites from honey bee colonies.

MATERIAL AND METHODS

Beevital Hive Clean (Austria) according to the producer's label contains: water, sucrose, oxalic acid, citric acid, propolis and essential oils.

The trial was carried out in a Lower Silesia apiary consisting of 10 colonies in Dadant hives (frame 435 x 300 mm) equipped with a mesh bottom board and a collecting tray under it. Colonies were obtained as bee-packages in May from a local producer. Beevital Board (Austria) - sticky paper placed on trays below the

mesh hive bottom board were used to control mite fall. Natural mite fall was counted daily, just before preparation application, for 3 consecutive days (September 19 - 22). The counting was performed as a background measure - serving as a control value to the results of applied treatment within the same colonies. No varrocidal treatments were performed till autumn when three applications of Beevital Hive Clean (Austria) were applied 7 days apart according to producer recommendations. The treatments were done on September 22; September 29 and October 6, 2008. The Beevital Hive Clean preparation in a total of 15 cm³ was trickled on bees between the frames of each colony. Mites were counted at the end of the 1st day (24 h fall). Joint fall was counted for the 2nd to 3rd day and for the 4th to 7th day as well as after each preparation treatment. Sealed brood area per colony was estimated at the beginning and at the end (September 22 and October 13). Weather conditions during the period of the trial were monitored. Recordings of the mean daily temperature in nearby Wrocław - Swojec meteorological station were done. The number of bees in the colonies was documented on November 11, 2008, by taking photographs of combs occupied with bees and then counting them. Bee

samples (154 - 218 specimens per colony) were then collected to determine the *Varroa destructor* infestation rate in each colony using detergent washing of bee samples and counting fallen mites on a sieve.

Results were calculated as: natural mite fall before preparation application [n/day], mite fall in consecutive periods after Beevital Hive Clean application [n], total mite fall within 7 days after a single application of the preparation [n], total mite fall during the 3 week period [n], mite infestation rate of bees in colonies [n mites/100 bees] and total number of bees for wintering in November [n], number of mites which remained for wintering in colonies [n] and finally mite removal efficacy with Beevital Hive Clean [%].

RESULTS

The mean daily temperature during the trial (September 19 - October 13, 2008) averaged +10.71°C, with the minimum and maximum temperatures respectively 7.9 and 13.2°C. There was still an average of 0.55 (from 0.0 to 1.0) frame of sealed brood in each colony during the first treatment; in the first week of mite fall

Table 1
Varroa destructor mite fall after the 1st, 2nd and 3rd Beevital Hive Clean treatment in consecutive day-periods

Treatment and date		1 st day after treatment	2 nd and 3 rd day after treatment	4 th to 7 th day after treatment
I 22.09.	Mean	33.1	117	108.1
	SD	15.2	37.04	42.48
	(range)	(7 - 55)	(58 - 168)	(43 - 187)
II 29.09.	Mean	212.7	125.1	42.5
	SD	111.18	67.56	28.51
	(range)	(66 - 416)	(30 - 236)	(9 - 104)
III 6.10.	Mean	44.7	44.9	12.9
	SD	31.89	36.79	6.72
	(range)	(6 - 95)	(7 - 94)	(4 - 22)

Table 2

Varroa destructor mite fall [n] before and after consecutive treatments with Beevital Hive Clean from September 22 to October 13.2008

Colony	Natural daily mite fall before treatments	1 st treatment	2 nd treatment	3 rd treatment	Total mite fall
1	5	321	394	199	914
2	9	325	231	54	610
3	19	291	607	42	940
4	10	254	641	159	1054
5	20	109	329	205	643
6	12	294	346	40	680
7	4	313	132	20	465
8	6	138	152	128	418
9	28	217	633	132	982
10	17	320	338	46	704
Mean	13	258.2	380.3	102.5	741
SD	7.78	78.88	190.04	70.27	220.59
(range)	(4 - 28)	(109 - 325)	(132 - 643)	(20 - 205)	(418 - 1054)

Table 3

Number of bees and *Varroa destructor* mites in colonies for wintering and mite removal efficacy of Beevital Hive Clean treatment used 3 times

Colony	Estimated number of bees per colony Nov. 11 [n]	Varroa mites/100 bees Nov. 11 [n]	Varroa mites remaining for wintering [n]	Efficacy of Beevital Hive Clean [%]
1	6853	0	0	100
2	5760	1.6	92	86.9
3	5454	0.5	27	97.2
4	7252	0.9	65	94.2
5	7785	1.3	101	85.4
6	5478	1.4	77	89.8
7	4060	0.6	24	95.1
8	5862	1.2	70	85.3
9	8372	1	84	92.1
10	7337	1.1	81	89.7
Mean	6421	0.97	62.1	91.6
SD	1313.65	0.48	33.46	5.04
(range)	(4060 - 8372)	(0 - 1.6)	(0 - 101)	(85.3 - 100)

caused by preparation use. There was no brood recorded after the third treatment.

The pattern of mite removal from bee colonies in which Beevital Hive Clean had

been used, was uneven and differed between treatments (1st vs. 2nd vs. 3rd) and between consecutive day-periods after treatment (Tab. 1). The highest level of

mite fall was observed on the 2nd and 3rd day after the first treatment (58.5 mites per day). In the two following treatments the fall was the highest on the 1st day after application (consequently: 212.7 and 44.7 mites removed per day).

Natural daily mite fall in September - used as control measure to consecutive treatments - ranged from 4 to 28 mites per day per colony, with a mean of 13.0 ± 7.78 specimens (Tab. 2). Consecutive individual treatments were characterised as having different rates of mite removal from bee colonies (Tab. 2). The second application of Beevital Hive Clean (380.3 ± 190.04 mites removed per colony) was found to be the most effective while the first and third applications caused a removal of 258.2 ± 78.88 and 102.5 ± 70.27 mites respectively. All three applications of the preparation on average removed 741 mites per colony, from 418 to 1054 specimens in a single colony.

Number of bees for wintering, as estimated in November, was an average of 6421 (from 4060 to 8372 bees in a single colony). Ratio of mites to bees in a colony in November, based on the flotation method used, was on the average of 0.97 mite per 100 bees with the range from 0.0 to 1.6 mites. Taking into account data about bee population numbers and the infestation rate of bees, the number of mites remaining after the autumn application of Beevital Hive Clean was calculated to be on an average of 62.1 mites per colony (from 0 to 101 mites) (Tab. 3). The efficacy of removing mites in 10 tested colonies averaged 91.6% with the range from 85.3 to 100% on an individual colony basis (Tab. 3).

DISCUSSION

The average efficiency of mite removal obtained in the current study is lower than reported by Pohorecka et al. (2009b) - from

95.8 to 98.4% depending on the number of treatments, but higher than reported by Akyol and Yeninar (2008) in Central Anatolya (Turkey) - 88.7%. These authors compared the results of Beevital Hive Clean action to the Apiwarol preparation (amitraz) as a reference because Apiwarol has a perfect, 100% efficacy. Such methodology may be biased since despite very high efficiencies reported for amitraz in the literature, it is often below 100% (Konopacka et al., 2002). The results of the use of Biowar (amitraz in the form of strips) depended on the year of application and the length of time of exposition in the bee colony. Differences in the efficiency of the Biowar preparation ranged from 3.0 to 8.0% in the data of Pohorecka et al. (2009a) to over 6% in the research done by Chuda-Mickiewicz et al. (2007).

Alternative chemical treatments have gained more acceptance in recent years, as they are perceived to be more natural in origin. Alternative, natural varroa treatments are cheaper and less harmful to the bee environment but they are also less reliable. The most commonly used alternative compounds are formic acid and oxalic acid. Mutinelli et al. (1997) reported mite fall in the order of 95% when oxalic acid was used. Semkiw et al. (2008) reported in field tests that varroacidal efficacy for oxalic acid was 99.0%, however its efficacy found by Sas et al. (2008) was only from 80.6 to 92.5%.

Essential oils and plant extracts have also been tested in varroa control. The majority of these extracts cause the mites to release from the bees, but do not cause mite mortality (Calderone and Spivak, 1997; Sammatoro et al., 1998). Skubida and Semkiw (2009) obtained an average efficacy for Api Life Var, containing thymol, as 90.8% but the range of results was from 60.6 to 98.9%.

The range of a 14.7% difference in efficiency of Beevital Hive Clean in single

colonies in the autumn, was reported in the present study. Other research data showed variable results of varroa control in individual bee colonies (Chuda-Mickiewicz et al., 2007; Sas et al., 2008). Maximal or an average efficacy is not enough information to characterise any preparation success in control of the varroa population. A range of results obtained from different colonies is needed in order to assess preparation use in a more correct manner.

CONCLUSIONS

The mites release from the bees with no direct mite mortality is a feature of mild acting preparations. The sticky board to immobilize fallen mites as well as cold hive bottom board in the autumn may increase the efficiency of these preparations. Oxalic acid alone is recommended as a late autumn application in bee colonies. Beevital Hive Clean preparation contains oxalic acid combined with citric acid and essential oils which may warrant more stable efficiency than single component preparations. A minimum 3 time application of Beevital Hive Clean is justified since substantial mite fall was recorded after each of the 3 consecutive applications. When Beevital Hive Clean used in 3 applications, was considered as one complete varrocidal treatment (100 % of mites removed), 34.9 % of mites were removed after the 1st, 51.3 % after the 2nd and 13.8 % after the 3rd application.

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SKUTECZNOŚĆ (EFEKTYWNOŚĆ) USUWANIA *Varroa destructor* PREPARATEM BEEVITAL HIVE CLEAN

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S t r e s z c z e n i e

Na przełomie września i października 2008 roku we Wrocławiu zastosowano do usuwania inwazji *Varroa destructor* preparat ekologiczny Beevital Hive Clean (Austria) w 10 rodzinach pszczoły miodnej. Skuteczność usuwania pasożyta określono na podstawie kontroli jego osypów w każdej rodzinie, podczas 3 tygodni działania preparatu. Miesiąc po zakończeniu działania preparatu oszacowano liczbę pszczoł w każdej rodzinie i poziom inwazji pasożytów. Na podstawie liczby usuniętych pasożytów podczas stosowania preparatu do liczby roztoczy jaka pozostała w rodzinach określono skuteczność preparatu Beevital Hive Clean na średnim poziomie 91,6% (od 85,3 do 100,0% w poszczególnych rodzinach).

Słowa kluczowe: *Varroa destructor*, pszczoła miodna, Beevital Hive Clean, skuteczność.