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THE CONTROL OF VARROA MITE IN ORGANIC APICULTURE

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Abstract

The begining of organic apiculture in Hungary can be followed since the mid nineties based on 834/2007 EU Council Regulation, 889/2008 Commission Regulation and 79/2009 FVM (MARD) Regulation. We studied the possibilities of Varroa destructor control with accepted materials in the organic system. In Hungary in the conventional beekeeping practice even today the amitraz based chemicals are widely used which are not accepted under the organic regulation, thus the transition from this method gives high challange to the beekeepers. The succesful varroa control is one key factor of organic operation as well. In the paper the experimental results of timol and oxalic acid treatments are presented with the efficacy values. The results show that the efficacy varied between 47,9-96,4% there was significant difference in the number of dead mites as well. The results suggest that the only timol based control strategy can ensure a limited (1-3 year) sustainability of the treated colonies concerning profit oriented production. The different, oxalic acid based control resulted in significantly higher mite mortality. Other technological factors may have important role in the control strategy against Varroa destructor especially in organic apiculture.

Keywords: apiculture, organic farming, Varroa destructor

Varroa atka elleni védekezések az ökológiai méhészetekben

Összefoglalás

Az ökológiai gazdálkodás kezdetei hazánkban a ’90-es évek közepétől követhetők nyomon ebben az ágazatban, amely a következő rendeletek alapján folytatható: 834/2007 EU Tanácsi Rendelet, 889/2008 végrehajtási, ill. a 79/2009 FVM rendelet. Munkámban a Varroa destructor (Ázsiai nagy méhatka) elleni védekezési lehetőségeket vizsgáltam az ökológiai rendszerben engedélyezett szerekkel. Hazánkban a konvencionális gyakorlatban napjainkban is széles körben alkalmazzák az amitráz hatóanyagú készítményeket, amelyek nem engedélyezettek az ökológiai szabályozásban, így az erről történő átállás jelenti az egyik jelentős kihívást a méhészeknek. A parazita elleni védekezés sikeres megvalósítása ebben a rendszerben is az eredményes méhészet kulcs tényezője. Munkámban a timolra és oxálsavra alapozott kísérleti eredményeket mutatom be, ismertetve az egyes szerekkel elért több éves hatékonyságot is. Az eredmények alapján megállapítható, hogy a kezelésekben alkalmazott szerek hatékonysága 47,9-96,4% között változott, szignifikáns különbség volt az elpusztult atkák számában is. Vizsgálataink szerint, a mindössze timol hatóanyagra alapozott védekezés csak rövid ideig (1-3 év) biztosíthatja a méhcsaládok eredményes termelést biztosító fenntarthatóságát, a különböző idejű oxálsavas kezelések lényegesen jobb atkapusztulást eredményeztek. A méhészetben alkalmazott egyéb technológiai tényezők szerepe az ökológiai rendszerben is jelentős szinergikus hatással rendelkezhet a varroa atka elleni védekezési stratégiában.

Kulcsszavak: méhészet, ökológiai gazdálkodás, Varroa destructor

Introduction

Honeybees and man have a very long common history. Although there are several pests and enimies of the honey bee (Apis mellifera) most colonies could easily survive especially with the aid of the good management practice. The new parasite mite, Varroa destructor, formerly classified as V. jacobsoni from Asia was first detected in Hungary in 1978 has changed the former beekeeping strategy (*Örösi*, 1975).

Since V. destructor is a new parasite of the honey bee A. mellifera, thus a balanced host–parasite relationship is lacking and beekeepers do not have long-term experience in dealing with this pest. Most of the colonies of A. mellifera in temperate climates will be damaged or even collapse within a few years if no control or inappropriate control methods are used (*Rademacher and Harz*, 2006). Nowadays, beekeepers utilize a wide range of different chemical substances, application techniques and methods to keep mite populations under control. Regular treatments increase the costs for beekeeping and the risk of chemical residues in bee products (*De la Rua et al*., 2009).

Stricter food quality regulations and the risk of contamination have influenced apiculture as well. The European Community in 1991 described and regulated the so-called organic (ecological) production. The begining of organic apiculture in Hungary can be followed since the mid nineties (*Szalay*, 1999). At present the most important regulations are 834/2007 EU Council Regulation, 889/2008 Commission Regulation and in Hungary the 79/2009 FVM (MARD) Regulation related to apiculture.

Over the last 15 years, the most noted synthetic acaricides against V. destructor are the organophosphate coumaphos, the pyrethroids taufluvalinate and flumethrin, as well as the formamidine amitraz. These are all classified as relatively hard acaricides. Difficulties with the use of these varroacides are: the repeated use of the products results in the development of resistance. Mite resistance has been reported for almost all varroacides used, cross-resistance to all the pyrethroids used against varroa has been found in many varroa populations (*Milani* 1999, *Elzen et al* 1999).

These chemicals may harm bees when bees are simultaneously exposed to multiple compounds stored in wax (*Chauzat et al*., 2009; *Wallner*, 2005). They can sustainably pollute the honey and other bee products (*Wallner*, 1999). Contamination of bee's wax even persists through commercial recycling. Because several types of wax residues also may have some effect on mites in the sealed cells (*Fries et al*., 1998), they are likely to create acaricide resistance.

Organic acids and essential oils can be used as alternative control tools. Formic acid, oxalic acid, lactic acid and thymol represent the frame of natural compounds used for the control of Varroosis (*Calderone*, 1999; *Fries*, 1989; *Nanetti* et al., 2003; *Rademacher* and *Harz*, 2006; *vanEngelsdorp et al*., 2008). The general advantages of these natural compounds are: Sufficient efficacy against V. destructor

(*Fries*, 1991), low risk of residues and accumulation in bee products. Most of these substances are water soluble and/or volatile and natural ingredients of honey. Therefore, contaminations of honey or bees' wax are unlikely, low risk of resistance (*Bogdanov*, 2006;)

However, there are also some disadvantages of these natural compounds. Lactic acid and oxalic acid have to be applied under broodless conditions (*Higes et al.*, 1999). Climatic and hive-colony conditions and the mode of application have to be carefully tuned for the optimal effect. The range between efficacy on the parasite and toxicity for the host, is narrow (*Higes et al.*, 1999). The effects from organic acids and essential oils often are more variable, compared to registered hard acaricides.

Since at the beginning the practical application of the soft acaricides has resulted lower effects on the targeted mites or even caused unwanted side effects on bees and eggs or climatic and other beekeeping conditions could modify the control method. Our aim was to compare two basic types of these acaricides (essential oil and oxalic acid) in different treatments that can be applied in certified organic apiaries as well.

Material and Methods

The experiment was set up in Gödöllő, between 2006-2009, with four treatments in four replications n=16 colonies.

The colonies were managed in the so-called ½ nB hive (frame size: 42 X 18 cm, 10 combs/super). The strength of the colonies was equalized in two supers in spring, 2006. Modified bottom board made possible to monitor mite fall without colony disturbance. The migration of colonies made possible to reach two Black locust (Robinia pseudoacacia) and sunflower (Helianthus annuus) pasture, which was the source of the extracted honey as well.

Treatments were as follows:

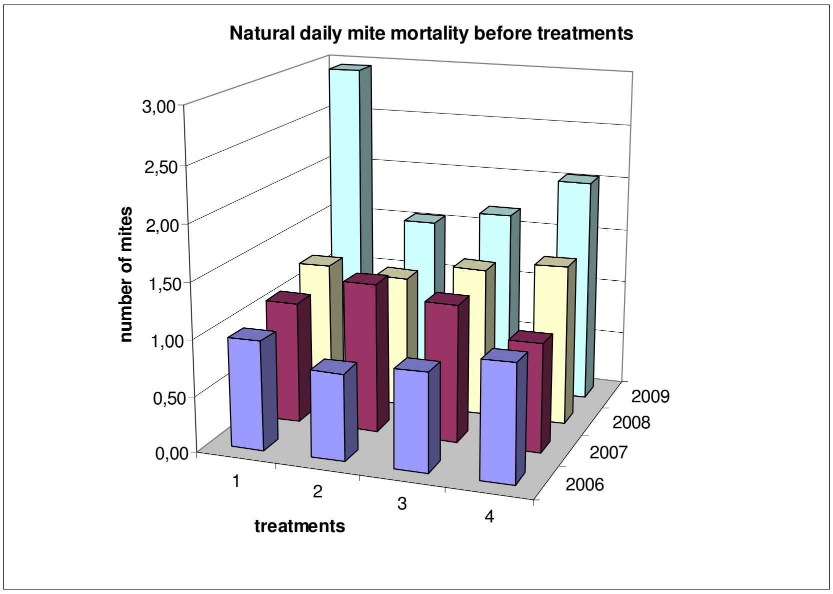
1. thymol 2-fold (Apiguard, 25% timol, 50g)
2. oxalic acid solution 3,5% 1 (Api-Ox, broodless period, trickling 50 ml)
3. essential oils + oxalic acid solution 3,5% 2-fold (Bee-Vital-Hive-Clean, trickling 30 ml)
4. oxalic acid solution 3,5% 2-fold (Api-Ox limited brood and broodless period, , trickling 50 ml)

In the first and fourth experimental years (2006, 2009) to calculate efficacy a final control treatment of coumaphos (Perizin) was applied in all treatments. The daily natural mite mortality was monitored before the first treatments. The number of dead mites before and after the treatments was counted using the bottom screen. Efficacy of the treatments was calculated according to *Fries et al*., 1991.

Results and discussion

In the first year no significant differences within the natural mite mortality could be found in *Figure 1*. During the whole experimental period high increase in the number of dead mites could be detected in the Treatment 1 in the last year. It shows that mite population could grow due to the limited control.

Figure 1 **Natural mite mortality before treatments**



Before treatments the natural mite mortality in the 1st year varied between 0,42 and 0,78 with high variance (0,40-0,65), while in the 4th year it varied between 0,95 and 2,75 (variance of 0,68- 1,52). During this period mite drop was significantly higher in treatment 1 ($P< 0,005$)

Figure 2 shows the number of dead mites after the first and second treatment and in addition the last application of coumaphos (Perizin) as the final control to calculate the efficacy of treatments (the upper green line) demonstrating the percent of efficacy. The results show that the efficacy varied between 47,9-96,4 %, there was significant difference in the number of dead mites as well ($P< 0,005$). In treatment 1the second application of thymol increased mite mortality, however efficacy did not reach 50%. Treatments 2, 3 and 4 had no significant differences in efficay in both years, although we could only exceed the 90% in 2009.

The results suggest that the only timol based control strategy can ensure a limited (1-3 year) sustainability of the treated colonies concerning profit oriented production. The different, oxalic acid based control resulted in significantly higher mite mortality. Other technological factors may have important role in the control strategy against Varroa destructor especially in organic apiculture. Developing drone brood was removed as general recommendation in organic mite control. In Hungary profit oriented organic apiculture needs control efficay against Varroa destructor near to 90%. Oxalic acid solution is effective mainly in the broodless periods. In our case no significant difference was found between the two oxalic acid Treatments No. 2 and 4. If other technological tools are properly applied and there is no reinfestation of colonies one teratment ensured over 80% and 90% efficacy in 2006 and 2009, respectively. In Treatment 4 the lower efficay was calculated in 2006. The daily mite drop was only 10 during the first application in both years. It seems that the limited brood conditions could not ensure higher mite mortality thus within the brood present mites could survive and propagate.

Figure 2 **Effect of treatments on mite mortality and efficacy in 2006 and 2009**

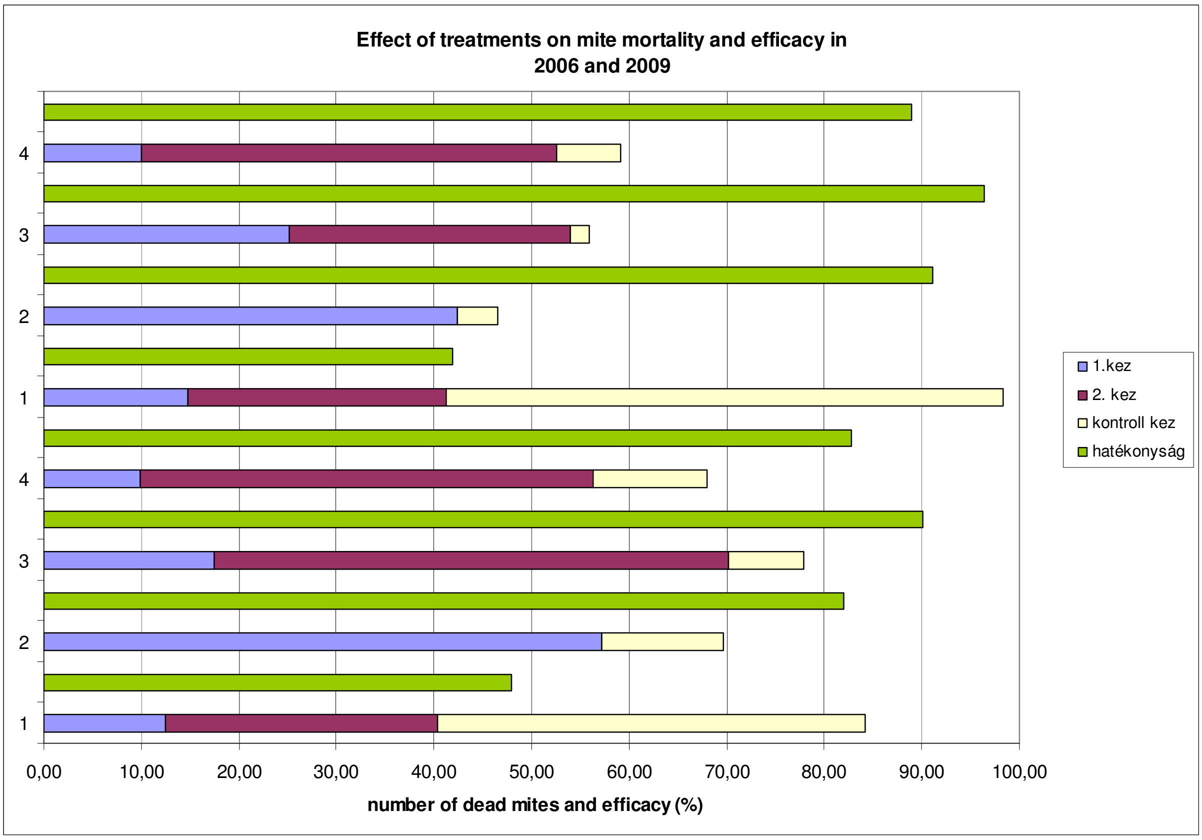
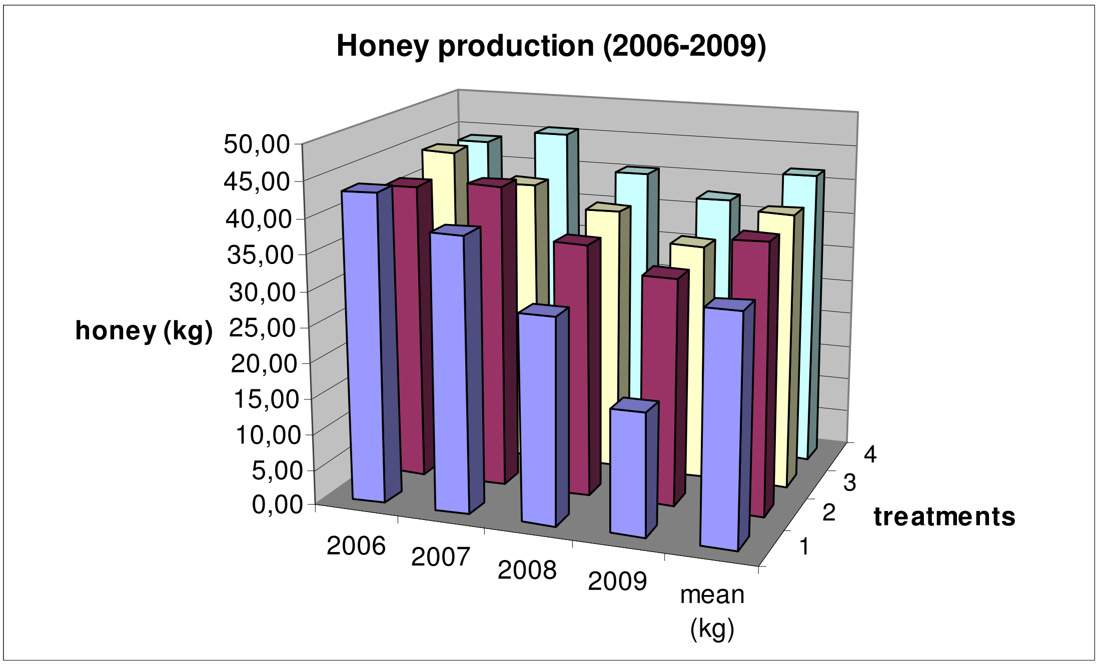


Figure 3 represents the total honey yield of the experimental colonies from two harvests of Robinia pseudoacacia and Helianthus annuus. Significant decrease can be observed in 2009 in Treatment 1. It was the result of of one colony loss during overwintering. It seems that colonies could tolerate the limited efficacy mite control only for a shorter period (3-4 years) in case of this treatment, however decreasing tendency in the yield could be followed not only in this treatment.

Figure 3 **Honey production and mite control between 2006-2009**



Conclusions

In organic apiculture mite control is different than in the conventional ones. The so-called soft type of acaricides may ensure colony survival and strength with an accepted honey yield level. The decision and application of control materials need wider information and the ability of frequent monitoring of bee and mite population. Colony and environmental conditions may significantly modify control efficacy thus flexibility and the adjustment of technology may be requiered.

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