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Short Communication

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Hungarian on-farm research program for varroa control in organic beekeeping

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Varroatosis as the current bane of the beekeepers is causing the biggest economic damage in the apicultural sector. Consistent control of varroatosis should be provided without harmful effects such as the occurrence of toxic residues in the hive products. In the technology of organic beekeeping only natural materials are allowed to be used such as essential oils and organic acids. Since 2013 within the beekeeping on-farm research program, we are collaborating with beekeepers throughout Hungary in comparative trials for testing the efficacy of different types of varroa control treatments and management practices. The trials are set up in market operations. One essential task of the program is to monitor the infestation level systematically with practical mite-counting techniques.

Keywords: organic beekeeping, on-farm research, varroa control

1 Introduction

Varroa mites have a vector role, distributing viruses and weakening bees that become more susceptible to other pathogens as well. Disorientation, robbing, and frame exchanging may transport mites from one colony to another (Oliver, 2011). There are no colonies without mites in Hungary. The infestation level increases over time in colonies that are untreated or not managed regularly. The continuous build-up of mite population causes slower colony build-up, less honey production, risk of viral epidemic, poor wintering, or at worst, colony collapse. The infestation level should be kept as low as possible for a sustainable production. Any intervention in the colony against mites may cause disturbance and expense, therefore timing and the type of method chosen has great relevance.

The degree of varroa infestation must be measured in a timely manner in order to determine what efforts are needed to to keep the mite population below the economic threshold level. Oxalic acid (OA) is one of the most common natural acaricides used against varroa throughout Europe. Its efficiency is well known since the middle 1980s mainly from experiments performed in Eastern-Europe and Asia on spraying and sublimation administration techniques (Nanetti, 2003). Lactic acid (LA) occurs naturally in floral honeys (Puhan et al., 1973) and several field and laboratory tests (Imdorf et al., 1990; Assman-Wertmüller et al., 1989) have shown its acaricidal properties. Similarly, numerous studies showed formic acid to be effective against varroa (Hoppe et al. 1989; Feldlaufer et al., 1997). Our short communication present the practical results of testing these substances under real-life organic conditions in 2014.

2 Material and Methods

2.1 Experimental setup

In 2013 the Hungarian Research Institute for Organic Agriculture (ÖMKi) and 20 beekeepers launched a participatory research team in frame of an apiculture on-farm program. True on-farm research involves producers in determining experimental design, in collaboration with scientists and extension providers. Farmers conduct or actively help to conduct the experiment, providing a real-life setting in which to test previously agreed methods. In our

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case a comparative study of commercial products for organic beekeepers, in combination with bee management methods were set up. At the beginning of the beekeeping season each beekeeper selected 12 hives from their operation and made 3 groups of (3*4) colonies per apiary. The beekeepers were chosen from different locations of Hungary for aquiring more representative geographical data. The timing of treatment periods and the method of bee management method depended on the honey flow seasons and the type of beekeepers' equipment.

2.2 Monitoring mite levels

In practice instead of calculating the total colony infestation rate the recommended seasonal threshold levels were adapted to local conditions. Thresholds were defined so as to keep infestation surely under the economic injury level (Amsler et al., 2009). The types of threshold levels were the natural 24-hr mite drop count and the rate of phoretic mites on sampled adult bees. For counting the natural drop of phoretic mites from the bees the sticky board under a screen method was used (Martin, 1998). The average natural 24-hr mite drop count was calculated from one week periods.

2.3 Treating and inspecting

The timing of treatments and the type of applied methods in 2014 are shown in Table 1. Because of the treatment timing setup the monitoring periods carried out right before a treatment were in some cases the backup measurements of the previous treatment as well. The backup monitoring was following a week after the treatments to avoid counting mites that have fallen directly due to the treatments. Until late summer groups of untreated colonies were kept as control samples for monitoring natural mite population development. From this time onwards the former untreated colonies were divided into two groups and were also involved in the following comparative trials. The infestation levels of the colonies were compared to their former warroa infestation stages. In the comparison trials commercial products and devices were tested.

Table 1 The timing and the type of methods in the comperative trials. OA = oxalic acid; FA = formic acid; CA = citric acid; LA = lactic acid; m/d = average natural mite fall in 24 hours. (The percentage figures are the infestation stage changes)

period	activity	method groups and infestation states			threshold levels
2nd week of January	monitoring	0 m/d	0 m/d	0 m/d	0,1 m/d
2nd week of June	monitoring	0,5 m/d	0,5 m/d	0,5 m/d	0,7 m/d
3rd week of June	treatment	dribbling OA+FA	untreated controll	dribbling OA+CA	
2nd week of July	monitoring	600% (3,5 m/d)	450% (2,7 m/d)	380% (2,4 m/d)	5 m/d
3rd week of August	monitoring	10% (3,9 m/d)	10% (3 m/d)	10% (2,6 m/d)	6 m/d
4th week of August	treatment	sublimating OA		sublimating LA	
3rd week of Septembre	monitoring	-20%		-27%	5 m/d
4th week of Septembre	treatment	evaporating FA gel		evaporating FA paper	
3rd week of Octobre	monitoring	-39%		-27%	2 m/d
4th week of Octobre	treatment	sublimating OA		sublimating LA	
2nd week of Novembre	monitoring	-68%		-50%	0,7 m/d
3rd week of Novembre	treatment	dribbling OA+FA		dribbling OA+CA	
2nd week Decembre	monitoring	-52%		-58%	0,3 m/d
3rd week of Decembre	treatment	sublimating OA		sublimating LA	
2nd week of January	monitoring	-70%		-68%	0,1 m/d

3 Results

The infestation level of the treated colonies stayed under the threshold level throughout the year. In the comparative trials of dribbling mixtures in June and November the combination of OA and CA showed to be more efficient than the combination of OA an FA. In the comparative trials of sublimation methods in August and October LA induced slightly higher changes in the infestation stages. In practice sublimation technique was carried out with less physical effort and disturbance compared to the dribbling treatments. The direct mite drops caused by the sublimation treatment are surprisingly high. In the comparative trials of FA evaporating devices the gel packs were easier to install and they were more effective than the barred cages with evaporator papers. Despite the good mite-fall results, the colonies that were treated with FA in September had unexpected queen losses and the winterbees had an earlier generational change in early spring of 2015.

4 Conclusions

The method of counting natural mite-fall proved to be a good practice for monitoring varroa infestation stage of colonies without disturbing the bees. The calculations of infestation stage changes were suitable for gathering comparable data from different apiaries and allowed good analysis of the datasets. However, the rate of infestation stages were significantly high in the spring period surprisingly all combination of treatment methods resulted low infestation stage until the end of the beekeeping season. The on-farm research program for varroa control in organic beekeeping continued in 2015. Results will be complemented with comparative trials of essential oil preparations.

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