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Short Communication

Summary of winter honey bee colony losses in Slovakia between the years 2009 and 2015

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Between the seasons 2009/2010 and 2014/2015 was evaluated 1305 questionnaires in total, received from Slovak beekeepers. Standard questionnaires of COST working group COLOSS were used with sets of questions related to overwintering of bee colonies and possible reasons of its losses. In season 2009/2010 winter losses in Slovakia reached 7.10 %, subsequently in 2010/2011 – 5.96 %, 2011/2012 – 9.70 %, 2012/2013 – 9.50 %, 2013/2014 – 8.84 %, 2014/2015 – 10.00 %. Expected causes of winter mortality (starvation, poor queen´s quality, parasitism, robbery) were evaluated in the study to detect the presence of depopulation syndrome of bee colonies – CCD (colony collapse disorder) reported from some North American and European areas. As acceptable level of winter losses is generally considered level 10 %, which was not exceeded in any season, thereby Slovakia ranks among countries with the lowest winter mortality of bee colonies worldwide. Possible reason of this situation is most probably multiple *Varroa* treatment throughout the year, but other reasons are discussed as well in the study.

Keywords: bee colony losses, honey bee, beekeeping

1 Introduction

The phenomenon of heavy losses of bee colonies is documented in the history of beekeeping. Many factors have been identified as a key reason of bee mortality, such as parasitic bee mites *Acarapis woodi* and *Varroa destructor*, bacterial or viral infections (Hung et al., 1996). New wave of bee colonies collapses has begun in 2006 in the USA (Johnson, 2007) and soon also in some European apiaries. Beekeepers in the United States attributed the mysterious collapse to the new syndrome named Colony Collapse Disorder – CCD, which is characteristic by sudden disappearing of bees from the hive when only a few young bees with a queen can be find within the bee colony (Kaplan; 2008). In most of European countries is as a main reason of bee colonies mortality considered parasitic mite *Varroa destructor* and *Nosema* spp (Martin-Hernandez et al., 2007, Neumann, 2008). High honey bee colony losses have been observed in recent years in many countries (Van der Zee et al., 2012, 2014). This has led to intensive co-operation between honey bee experts to investigate this problem from different perspectives, including epidemiology and experimental approaches. A milestone in this co-operation was the formation in 2008 of the honey bee research network COLOSS (Prevention of honey bee COlony LOSSes), intended to intensify contacts and research collaboration between honey bee experts (Neumann and Carreck, 2010). From the beginning is a part of this monitoring network also our Department, so the data collected from Slovakia are fully comparable with more than 20 other countries. This study provide basic statistical data on bee colony losses in Slovakia in 5 subsequent seasons from 2009/2010 to 2014/2015.

2 Material and methods

The data used here result from the annual return of data from the COLOSS loss monitoring questionnaire (van der Zee et al., 2013) for the winters of 2009/2010 up to 2014/2015. Questionnaires were available in fillable forms on internet or in printed forms and beekeepers were requested to anonymously provide the data.

- From the questionnaire we have used following questions:
- In which region is situated your apiary?
- How many production colonies did you have before winter?
- How many of these colonies were lost during winter?

Winter period was described as the period between the moment that beekeepers finished the pre-winter

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preparations for their colonies and the start of the new foraging season. Colony lost was defined as dead colony, or reduced to a few hundred bees, or alive but with queen problems, like drone laying queens or no queen at all, which beekeeper couldn't solve.

- From the data obtained we have counted following data:
- Winter losses as a difference between the number of production colonies before and after winter.

Differences in winter losses among the regions of Slovakia.

All results were compared between the 6 monitored seasons. Software Statistica 8.0 was used to count statistical differences between data sets.

3 Results and discussion

For the whole period of 6 seasons monitoring 1305 questionnaires were completed. Data analysis showed that during the winter 2014/2015 beekeepers in Slovakia lost 10 % of bee colonies, which is the most during monitored seasons, as shown in Table 1. The lowest colony losses were recorded in season 2010/2011. Bee losses among the seasons were more or less balanced, with no significant statistical differences (P >0.05).

When comparing regional distribution of bee colonies losses in Slovakia, the highest losses were detected in Trnava region in 2013/2014 season – 37.02 %, the lowest in Prešov region during the same season – 0.78 %. Complete survey on regional distribution of winter losses among 8 Slovakian regions are shown in Table 2.

In six monitored winter seasons winter bee losses in Slovakia reached from 5.96 to 10 %. These losses are still considered among beekeepers as a "normal", since many of them may have been caused by wrong beekeepers practices, which might cause a starvation of bee colonies, autumn robbery between the colonies, not sufficient treatment against *Varroa* mites etc. In the season 2009/2010 varied bee losses in 24 countries between 7–30 % (Van der Zee, 2012) which ranks Slovakia between the countries with the lowest winter mortality (7.10 %). The overall loss rate in 19 mainly European countries in season 2012/2013 was 16.1 % (Van der Zee, 2014), bee colony losses in Slovakia were again considerably lower (9.5 %). Van der Zee et al. (2012, 2014) state, that distribution of colony losses at regional level showed a large variation within countries, which supports the notion that a complex combination of factors is causing colony losses. In most countries and in five monitoring years, hobbyist beekeepers (1–50 colonies) experienced higher losses compared with intermediate beekeepers (51–500 colonies). The same situation is visible also from our study, when inter-regional differences considerably differ between seasons and regions as well. The reasons of winters losses are not easily to define. Generalised linear mixed effects models (GLMMs) were used to investigate the effects of several factors on the risk of colony loss, including different treatments for *Varroa destructor*, allowing for random effects of beekeeper and region. Both winter and summer treatments were considered and the most common combinations of treatment and

Table 1 Bee colony losses in Slovakia during winters 2009/2010 to 2014/2015

Season	No of bee colonies in autumn	No of bee colonies in spring	Bee colony losses (%)
2009/2010	5152	4786	7.10
2010/2011	6023	5706	5.96
2011/2012	11015	10028	9.70
2012/2013	5851	5296	9.50
2013/2014	6266	5712	8.84
2014/2015	5780	5205	10.00

Table 2 Distribution of winter bee colony losses among regions of Slovakia (%)

Seasons / Regions	Banská Bystrica	Bratislava	Košice	Nitra	Prešov	Trenčín	Trnava	Žilina
2009/2010	2.53	6.10	**25.00**	8.60	5.08	6.51	11.47	7.29
2010/2011	5.85	3.33	5.72	4.51	4.77	7.65	6.42	9.43
2011/2012	**11.63**	**27.94**	7.14	8.62	6.34	9.89	19.88	19.35
2012/2013	9.74	12.88	4.04	9.05	**8.82**	8.34	10.83	**20.11**
2013/2014	2.61	11.29	1.96	**12.17**	0.78	1.90	**37.02**	3.92
2014/2015	8.53	14.93	14.93	11.65	3.79	**10.78**	30.39	10.46

timing were used to define treatment factor levels (Van der Zee, 2014).

They have find several possible reasons of higher losses, as the queen supersedure problems, access to foraging on maize and oilseed rape (risks to honey bees from neonicotinoid pesticides) or feeding bees with toxic sugar syrups. Significant results were achieved when comparing *Varroa* treatment strategies. This study demonstrates that beekeepers who treated the *Varroa* mite in summer and winter experienced lower risks of winter loss.

4 Conclusions

Compared with other mainly European countries Slovakia ranks among the countries with the lowest winter losses of bee colonies, which varied between seasons 2009/2010 and 2014/2015 from 5.96 to 10 %. The reasons of this relatively positive situation is the most probably the methodology of cross treatment of bee colonies against *Varroa* mite with several available Acaricides during summer, autumn and winter period, combined in many cases also with treatment during the honey flow seasons with organic acids. Potential threats of higher mortality shall be wider use of pesticide (as the summer poisonings were not included in our study), increased area under cultivation of maize and rapeseed as well as the recognition and correction of queen problems.

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