Journal of Apicultural Research and Bee World 49(4): 337-339 (2010)
DOI: 10.3896/IBRA.1.49.4.07

NOTES AND COMMENTS

Honey bee colony losses in Belgium during the 2008-9 winter

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Received 17 May 2010, accepted for publication 22 June 2010.

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Keywords: honey bees, colony losses, winter, Belgium

Over the last decade, beekeepers in many European countries have reported unusually high colony losses in their apiaries (Potts *et al.*, 2010). These reports have spurred a call for uniform and standardized methods to quantify losses consistently around the globe. In response, an international COST (European Cooperation in Science and Technology) network of bee researchers with the acronym COLOSS (prevention of honey bee COLony LOSSes) formed a working group (Working Group 1) to help develop survey tools to monitor overwintering losses (Nguyen *et al.*, 2010). Following the guidelines from this group, we present here the results of the winter loss survey performed in Belgium to quantify losses over the winter of 2008-9.

Ideally, winter mortality surveys would be done by randomly selecting beekeepers from a list of all beekeepers in a region. Unfortunately, in Belgium no such list exists, as only 2,200 of the estimated 8,600 beekeepers in the country are compliant with legal requirement to register their apiaries with the Belgian Federal Agency for the Safety of the Food Chain (FASFC). As the best alternative, a minimum of 5% of registered beekeepers were randomly selected in the 10 Belgian provinces. Selected beekeepers were individually interviewed by local agents and asked to respond to two questionnaires. The first questionnaire was developed by the COLOSS Working Group to ascertain colony losses; and asked the following questions: 1. In what locality or province do you keep your colonies?; 2. How many colonies did you prepare for wintering in the autumn of 2008?; 3. How many colonies were alive in the spring of 2009? The second questionnaire attempted to elucidate factors which may have contributed to colony mortality or survival and we report here the responses to the following questions: 1. How was your honey production in the season 2008-9 (nil, weak, normal, good)?; 2. Did you observe *Varroa destructor* in your colonies in the autumn of 2008?; 3. Did you observe honey bees with deformed wings in your colonies in the autumn of 2008?; 4. Did you observe a rapid decline in your adult honey bee population in the autumn of 2008?; 5. Did you observe the presence of crawling bees in front of your colonies in the autumn of 2008?; 6. Did you observe some winter starvation symptoms (no food, or food far away of the bees, or honey bees with their head in cells) in your colonies in the spring of 2009?

In total 176 beekeepers answered Questionnaire 1 which pertained to overwintering losses. These respondents represent 7.9% of all registered beekeepers and 2% of the estimated total number of beekeepers in the country. Of the beekeepers who responded to questionnaire 1, 76% (n = 135) also answered Questionnaire 2.

Total colony losses were calculated for individual operations, for the different Belgian provinces, and for the entire nation. The 95% Confidence Intervals (95% CI) around the point estimate of total losses (Dagnelie, 2006) were calculated. Total colony losses were used to determine average operational losses across Belgium and in the Belgian provinces. Total operational losses were compared between provinces using the Chi-square test with Bonferroni correction for multiple comparisons.

On average the number of colonies that the responding beekeepers had maintained in the autumn was 11.9 ± 0.7 (mean ± SE). Overall, 416 colonies were reported lost over the winter of 2008-9, representing a total loss of 19.9% [95% CI: 18.1-21.6%] and an average operational loss of 19.2% [95% CI: 15.2-23.2%]. This is nearly twice as great as the 10% winter loss deemed reasonable in

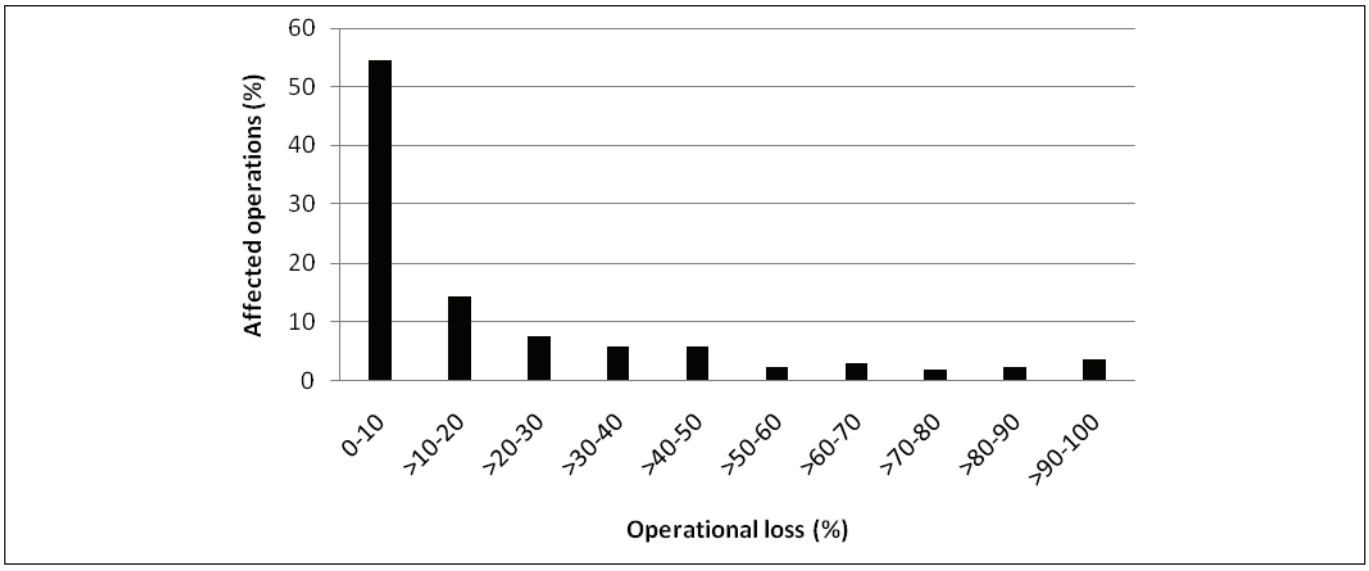

Fig. 1. Relative frequency of Belgian operations affected by different operational losses (in classes of 10%).

Belgium (Haubruge *et al.*, 2006). Nearly half, (45.5%) of responding beekeepers lost more than 10% of their colonies (Fig. 1), with 5.7% of respondents reporting 80% or more of their colonies lost.

Total winter losses exceeded 10% in all provinces except for Luxembourg, Namur and Flandre occidentale (Table 1). Significant differences were calculated between provinces ($\chi^2 = 59.7$, df = 9, $P < 0.001$). The high level of honey bee colony loss was surprising, because few complaints from beekeepers were reported during the 2008-9 season. This could be linked with the honey production, which was considered normal or good for most (55.6%) of the beekeepers interviewed, including those who had suffered severe colony losses. Mortality was statistically independent of the variable honey production ($\chi^2 = 1.955$, df = 1, $P = 0.162$).

Amongst apiaries where honey bee colony losses had occurred, those beekeepers reporting having observed *V. destructor* in their apiaries in the autumn (56.9%, N = 41) lost on average 30.3% [95% CI: 22.5-38.2%] of their colonies; those reporting the presence of honey bees with deformed wings in the autumn (29.2%, N = 21) lost on average 21.3% [95% CI: 15.3-27.2%]; those reporting a rapid decline in their adult honey bee population (26.4%, N = 19) lost an average of 43.4% [95% CI: 31.8-55.0%]; those reporting the presence of crawling bees in front of the hive (20.8%, N = 15) lost an

Table 1. Number of surveyed beekeeping operations and honey bee colonies for the 10 Belgian provinces, autumn 2008 to spring 2009. Total loss (and 95% confidence intervals) per province, and percentage of operations affected by losses of more than 10 % of their colonies are shown. Total loss followed by the same letters do not significantly differ ($P < 0.001$).

Province	**Operations (n)**	**Number of colonies in autumn (n)**	**Total loss % (95% CI)**	**Operations with losses > 10% (%)**
Belgium total	176	2095	19.9 (18.1-21.6)	45.5
Brabant Wallon	14	144	28.5 (21.1-35.8) a	71.4
Brabant Flamand	10	84	20.2 (11.6-28.3) ab	30.0
Anvers	39	535	25.2 (21.6-28.9) a	41.0
Limbourg	12	306	23.9 (19.1-28.6) ac	66.7
Liège	13	171	13.4 (8.3-18.6) bc	38.5
Namur	22	172	7.0 (3.2-10.8) b	22.7
Hainaut	23	220	20.0 (14.7-25.3) acd	56.5
Luxembourg	9	84	6.0 (0.9-11.0) bd	33.3
Flandre Occidentale	8	114	9.6 (4.2-15.1) bd	50.0
Flandre Orientale	26	265	20.8 (15.9-25.6) acd	50.0

average of 23.2% [95% CI: 15.4-31.1%]; and those reporting winter starvation symptoms in the spring (19.4%, N = 14) lost an average of 31.4% [95% CI: 21.7-41.2%].

In summary, the total colony losses in the winter of 2008-9, in Belgium (19%), is similar to the figures calculated in Italy (11%-38%) but lower than those in the USA (28%) and higher than in Croatia (13%), in Austria (9%) or Bulgaria (5%). The diversity of symptoms observed in the different apiaries has emphasised that we could attribute overwinter colony losses to many factors. In Belgium, recent studies do not support the involvement of the often blamed systemic pesticide imidacloprid (Nguyen *et al.*, 2009). Instead it seems likely that viral infections in combination with other honey bee stress factors, such as the microsporidium *Nosema ceranae* and the parasitic mite *V. destructor*, could play a key role in at least some of the losses (Berthoud *et al.*, 2010; Nguyen *et al.*, 2009; vanEngelsdorp *et al.*, 2009). Several ongoing projects at our laboratories are aiming to identify the actual causes of the honey bee colony losses in Belgium.

Acknowledgements

We are grateful to the beekeepers who participated in the study. This work was supported by the Service Public Fédéral: Santé publique, Sécurité de la Chaîne alimentaire et Environnement – VIRBEE RF6197.

References

BERTHOUD, H; IMDORF, A; HAUETER, M; RADLOFF, S; NEUMANN, P (2010) Virus infections and winter losses of honey bee colonies (*Apis mellifera*). *Journal of Apicultural Research* 49(1): 60-65. DOI: 10.3896/IBRA.1.49.1.08

DAGNELIE, P (2006) *Statistique théorique et appliquée. Tome 2. Inférence statistique à une et à deux dimensions*. De Boeck et Larcier; Bruxelles, Belgium.734 pp.

HAUBRUGE, E; NGUYEN, B K; WIDART, J; THOMÉ, J P; FICKERS, P; DEPAUW, E (2006) Le dépérissement de l'abeille domestique, *Apis mellifera* L., 1758 (Hymenoptera: Apidae): faits et causes probables. *Notes fauniques de Gembloux* 59: 3-21.

NGUYEN, B K; SAEGERMAN, C; PIRARD, C; MIGNON, J; WIDART, J; THIRIONET, B; VERHEGGEN, F J; BERKVENS, D; DE PAUW, E; HAUBRUGE, E (2009) Does imidacloprid seed-treated maize have an impact on honey bee mortality? *Journal of Economic Entomology* 102 (2): 616-623. DOI: 10.1603/029.102.0220

NGUYEN, B K; VAN DER ZEE, R; VEJSNAES, F; WILKINS, S; LE CONTE, Y; RITTER, W (2010) Coloss Working Group 1: monitoring and diagnosis. *Journal of Apicultural Research* 49(1): 97-99. DOI: 10.3896/IBRA.1.49.1.15

POTTS, S G; ROBERTS, S P M; DEAN, R; MARRIS, G; BROWN, M A; JONES, R; NEUMANN, P; SETTELE, J (2010) Declines of managed honey bees and beekeepers in Europe. *Journal of Apicultural Research* 49(1): 15-22. DOI: 10.3896/IBRA.1.49.1.02

VANENGELSDORP, D; EVANS, J D; SAEGERMAN, C; MULLIN, C; HAUBRUGE, E; NGUYEN, B K; FRAZIER, M; FRAZIER, J; COX-FOSTER, D; CHEN, Y; UNDERWOOD, R; TARPY, D R; PETTIS, J S (2009) Colony Collapse Disorder: a descriptive study. *PLoS ONE* 4 (8): e6481. DOI: 10.1371/journal.pone.0006481