Footnotes to varroa control

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Since beekeepers in Europe and elsewhere have started controlling the varroa mite several chemicals have come along. The reason for that is the rather quick resistance development of the mite against the chemicals, but in some cases also the bad (health-) reputation of some chemicals (carcinogenic) as well as too severe side effects on bees. Because the chemicals are applied inside the bee hive it is no surprise that residues can be found inside the bee hive, in wax, bee bread and honey stores..

In recent years concern has risen about chemicals from different sources which accumulate in the bee hive, partly because of the suspected role of neonicotinoids which can be found as residues in nectar and pollen, and can be collected by honeybee foragers and stored inside hives. This concern has led to a number of monitor studies on residues in bee matrices: in the USA plus Canada (Mullin et al., 2010), France (Chauzat et al, 2006, 2009, 2011), Spain (Bernal et al, 2010) and Germany (Genersch et al, 2010), most of this summarized in Blacquière et al, (2012). Noteworthy, although neonicotinoids and fipronil were looked for, especially chemicals of other functional groups proved to be the most abundant: fungicides and beekeeper applied acaricides.

In 2011 Wu et al showed in the laboratory that larvae of honeybees, reared in old frames containing several residues, did develop slower, and in addition had a lower life expectancy after emergence. These frames were shown to contain a cocktail of residues, dominated by the anti varroa chemicals coumaphos and fluvalinate, but also a few neonicotinoids in very low concentrations (each in one out of the 13 used frames. This was cited in VanderSluijs et al (2013) as being proof of negative effects to be caused by neonicotinoids). For this reason it was no luxury that Berry et al. (2013) took up research on the effect of the anti varroa chemicals coumaphos and tau-fluvalinate on the bees. They did apply the acaricides according to prescription, so this work is relevant for the normal beekeeping practice. Both chemicals are registered for use in beehives in the USA. Coumaphos (in Perizin) en tau-fluvalinate (in Apistan) have been registered and applied too in Europa including the Netherlands for many years. The authors added a treatment with copper-naphtenate, which is applied as a wood preservative on bee hives.

Berry *et al.* realized that it is not enough to just compare treated and not treated colonies, since apart from possible negative effects of the chemicals on bees, the treatment should be expected to control varroa mites which would benefit the colony. For that reason they monitored the mite infestation in all colonies during the one and a half year experiment, using three methods: mite fall on the bottom board; mite fall after powdered sugar dusting; mite counts in samples of 100 bees kept in alcohol. From these three ways of estimating the mite numbers they compiled a 'varroa-mite index'. In this way it was possible to analyse the effects of the mite index and of the chemicals both together and separate. Of course this was done in the expectation that in the coumaphos and tau-fluvalinate treated colonies fewer mites would be found compared to untreated colonies as well as colonies with the chemical Cu-naphtenate.

Results and by catch

Berry et al. investigated the effects of the chemicals on several parameters on both individual and colony level: survival of brood (day zero compared to day three); number of queen cells started; number of frames with bees and brood; homing speed (released from 500 m distance); frequency of middle, mid-heavy and heavy infested bees with Nosema; the weight at emergence of young bees; the percentage bees being successful in a PER conditioned learning assay; honey harvest; foraging activity of the colony.

The researchers found a few small differences between treatments (f.i. on learning – better with fluvalinate-, on emergence weight –higher with coumaphos, brood survival –better in control than in all chemical treatments). There was however no effect of the treatments on the colony level parameters. What did come out was the effect of the mite index: the higher mite index the worse the individual bees as well as the colonies performed. Of course knowing the reputation of Varroa this might be expected. The most surprising was however that no relationship could be found between the treatments applied and the varroa mite index found! In other words: treatment with coumaphos or tau-fluvalinate did not affect mite infestation. This by catch turns out to be the most important result of this study. The authors therefore conclude, considering that the chemicals are not effective but meanwhile have some negative effects on bees, it is high time to start with non-chemical control measures against varroa.

Where do we / they stand now?

Varroa is still a very negative factor for European honeybees, in Europe as well as in the USA. This is clearly shown with many experiments in Europe and in America. Hopefully in the end we can reduce the harm caused by varroa by selecting bees that are more varroa resistant. In Europe the damage by varroa is greatly controllable by intensive control measures, using organic acids (formic & oxalic acids) and etheric oils (Thymol). It appears that the organic-chemical approach is nearing its end. Unfortunately the large scale and the continental distribution of beekeeping in America limit easy application of organic acids.

References

Bernal J, Garrido-Bailon E, del Nozal MJ, Gonzalez-Porto AV, Martin-Hernandez R, Diego JC, Jimenez JJ, Bernal JL, Higes M. 2010. Overview of pesticide residues in stored pollen and their potential effect on bee colony (*Apis mellifera*) losses in Spain. Journal of Economic Entomology 103:1964-1971.

Berry JA, Hood WM, Pietravalle S, Delaplane KS (2013) Field-Level Sublethal Effects of Approved Bee Hive Chemicals on Honey Bees (*Apis mellifera* L). PLoS ONE 8(10): e76536. doi:10.1371/journal.pone.0076536

Blacquière T, Smagghe G, van Gestel CAM, Mommaerts V 2012 Neonicotinoids in bees: a review on concentrations, side-effects and risk assessment. Ecotoxicology 21:973–992

Chauzat MP, Martel AC, Cougoule N, Porta P, Lachaize J, Zeggane S, Aubert M, Carpentier P, Faucon JP. 2011. An assessment of honeybee colony matrices, *Apis mellifera* (Hymenoptera Apidae) to monitor pesticide presences in continental France. Environmental Toxicology and Chemistry 30:103-111.

Chauzat, MP, Carpentier P, Martel AM, Bougeard S, Cougoule N, Porta P, LaChaize J, Madec F, Aubert M & Faucon JP 2009. Influence of Pesticide Residues on Honey Bee (Hymenoptera: Apidae) Colony Health in France. Environ. Entomol. 38(3): 514-523

Chauzat, MP, JP Faucon, AC Martel, J Lachaize, N Cougoule and M Aubert. 2006. A survey on pesticide residues in pollen loads collected by honey-bees (*Apis mellifera*) in France. J. Econ. Entomol. 99: 253-262.

Genersch E, Von der Ohe W, Kaatz H, Schroeder A, Otten C, Büchler R, Berg S,Ritter W, Mühlen W, Gisder S, Meixner M, Liebig G, Rosenkranz P 2010. The German bee monitoring project: a long term study to understand periodically high winter losses of honey bee colonies. Apidologie 41, 332–352

Mullin CA, Frazier M, Frazier JL, Ashcroft S, Simonds R, vanEngelsdorp, D & Pettis JS 2010. High levels of miticides and agrochemicals in North American apiaries: implications for honey bee health. PlosOne 5(3), e9754. doi:10.1371

van der Sluijs JP, et al.: Neonicotinoids, bee disorders and the sustainability of pollinator services, Curr Opin Environ Sustain (2013), http://dx.doi.org/10.1016/ j.cosust.2013.05.007

Wu JY, Anelli CM & Sheppard WS, 2011. Sub-lethal effects of pesticide residues in brood comb on worker honey bee (*Apis mellifera*) development and longevity. PlosOne 6 (2), e14720.

Wu JY, Smart MD, Anelli CM, Sheppard WS 2012. Honey bees (*Apis mellifera*) reared in brood combs containing high levels of pesticide residues exhibit increased susceptibility to *Nosema* (Microsporidia) infection. J Invertebr Pathol. 109, 326-9 doi: 10.1016/j.jip.2012.01.005