Vital colonies thanks to complete brood removal

Do we not deprive bee colonies of their livelihood by removing their brood? After all, how quickly a colony deteriorates and its life force loses "vitality" becomes very clear when the queen is lost! But nonetheless, if done at the right time, removing a brood can have a rejuvenating effect because by doing so, one can significantly reduce germs and diseases, in particular the Varroa parasite. Dr Ralph Büchler describes how you can integrate brood removal into your beekeeping practices, at the same time minimising the use of anti-varroa drugs.

In view of high colony losses, significant feed expenses and frequent use of drugs one is forced to ask: how did bees manage to survive for millions and millions of years, unaided by anyone? Because, with a habitat spreading from the tropics to close to the Arctic Circle, the bees have always been exposed to pathogens and extreme climatic events. During all this time, they have always had to struggle with food shortages, a fact that has actually induced their extreme stockpiling habits.

So what is it then that lies at the root of the problem contemporary beekeepers are facing: chemical plant protection, green genetic engineering, electric smog and other innovations, as some assume? Or might there not rather be other factors such as bee breeding and keeping methods that have an adverse impact on the colonies' health and vitality? Natural protective mechanisms, from the individual's immune defence to the colony's multifaceted defence and hygiene behaviour and the consistent selection on population level as well as an adjusted density and distribution of the colonies in space, have been challenged by current beekeeping conditions. The continuous exchange of diseased bees between the colonies of an apiary, manifold disturbances of the natural brood nest system, the spread of unadapted bloodlines and the disregard of key vitality criteria in the breeding selection further aggravate the situation. The most severe interference in the natural protective mechanisms, however, is probably the prevention of swarming.

Learning from the swarm

It is a known fact that a swarm leaves most of the germs in the brood, in the food stocks and in the old comb cells and thus ensures hygiene at every fresh start. The infection cycle is stopped both in the swarm and in the remainder of the colony and the building of the new brood nest results in complete rejuvenation of the aged bee population.

Modern beekeeping's answer to uncontrolled swarming is a systematic formation of young colonies – often on the basis of brood combs. This eliminates the natural brood break (swarming) and moreover, the newly formed colony is equipped with all existing germs. Contrary to nature where diseased and weak colonies consistently fail, weak or diseased colonies are, without a thought, united with intact ones, which once again throws the doors wide open to further dissemination of the diseases.

For that reason, we were looking for a simple beekeeping method that retains the recovery mechanisms of swarming (separation of bees and brood, brood break, brood comb and colony renewal) without the beekeeper having to run after the swarms or to incur losses in yield. We came to the conclusion that the best solution is a one-time removal of the complete brood (see Work Procedure on page 11).

Extensive trial testing

After several years of using this complete brood removal for the renovation of colonies particularly heavily infected with varroa, the Bieneninstitut Kirchhain has been carrying out a scientific analysis of the impacts on colony development, disease infestation and honey yield of the colonies since summer 2007. In addition to two apiaries of the Institute with 16 colonies each, seven private partner operations were chosen to participate in this study throughout the German Bundesland of Hessen.

A one-time removal of the entire brood from the test colonies was carried out in June/July, using a trapping comb, and no summer treatment against varroosis was made. No brood was removed from the control colonies and these colonies were treated with formic acid or Thymovar shortly after the last honey harvest.

The number of occupied combs was determined repeatedly for colony development assessment. In September, bee samples were taken from food combs from the upper frame for analysis for varroa, nosema and different bee viruses. All honey harvested during the 2008 season was weighed for every colony.

Remarkably, complete brood removal does not result in a reduction of the population at start of winter. Due to the compact new building of the brood nest on hygienically perfect combs, the colonies manage to compensate the brood loss within a period of about 8 weeks. Therefore, with a brood removal by mid-July, the test colonies on average have a start into winter with at least an equal strength as the control colonies (see Table 1). There were also no negative effects over winter (population at winter's end 2008 compared with population at start of winter 2007) as well as during the honey harvest 2008. Although "only" one trapping comb was used and no other summer treatment was done, varroa exposure of the test colonies at the time of winter bee rearing was only slightly higher than that of the intensively treated control colonies (see Table 1, page 12) – the difference between the levels of infestation was statistically insignificant.

Complete brood removal
Work Procedure, Step by Step

1. Set down honey boxes and upper brood box and examine combs in brood nest area. Place a total of 2 – 4 light, well developed honey and pollen combs at the two sides of the lower frame.

2. Place a single brood comb with eggs and larvae, possibly without older, capped cells to avoid the emergence of any infested cells,

3. as trapping comb into the centre of the lower brood box. If available, drone brood is ideally suited for this purpose.

4. Now, push off as many bees as possible from all other brood chamber combs to the lower brood box. It is essential that also the queen ends up on the lower brood box! If you do not see the queen and are afraid to remove her together with the few bees remaining on the brood chamber combs, you will have to sweep all bees off the combs.

5. Finally, fill the spaces with light empty combs or foundation combs. If there is some honey flow, the comb foundations are quickly completed. Otherwise, feed with own honey.

6. Cover the lower brood box containing the queen with a protective grating. Place the honey chamber(s) on top of it as in the former arrangement. The brood chamber is only extended with a second brood box, if required, after harvesting the last honey chamber.

7. Place the removed brood combs with only a few bees on them into the "brood collector". In this process, combs of different colonies may be united without worries. One food comb with honey and pollen as supplies for the young bees is placed on each side. About 300 bees per comb side are sufficient to ensure supplies and the complete hatching of all brood cells. If you have swept the brood combs completely clear, you add the respective number of bees by pushing them from the honey chamber.

8. Control the colonies from which the brood was removed after 7 – 10 days. By then, the comb foundations are usually fully completed and the queen has built a new brood nest.

9. Remove the trapping comb that in the meantime has been capped to a large extent together with the mites trapped therein and melt it down. A comb foundation or empty comb put in its place will complete the brood comb renewal in the brood chamber. A varroa treatment is not necessary!

10. Bring the "brood collectors" on the same day the brood is removed to a separate apiary. You do not need to control them before 21 to 24 days. Until then, all the brood has hatched and all combs can be exchanged without problems. One or two brood boxes are left depending on the population size. If you are uncertain whether a supersedure queen is available you can make sure quickly with queen bee testing. Unsatisfactory supersedure queens can be easily replaced at a later stage.

11. Due to the temporary broodlessness, varroa control of the former "brood collectors" can now be effectively and easily carried out. Suitable for this purpose are the dropwise application of oxalic acid, spaying of lactic acid or the use of trapping combs.

Table 1: Colony development, varroa infestation and honey yield of the two comparison groups

Characteristic	Test colonies (brood removal)			Control colonies (varroa treatment)		
	n[1]	MW[2]	SF[3]	n	MW	SF
Population at start of winter, October 2007 and 2008 (occupied combs)	120	10,3	0,27	70	10,1	0,33
Overwintering quotient[4] 2007 - 2008	44	0,98	0,04	15	0,97	0,06
Honey yield 2008 (kg)	54	26,1	1,63	34	25,8	1,90
Varroa infestation in September 2007 et 2008 (mites / 10 g bees)	128	4,23	0,56	87	3,55	0,66

[1] Number of colonies [2] Mean Value [3] Standard Error [4] End of winter / start of winter

There were no significant differences also with the other analysed diseases (Illustration 1). In total, nosema only rarely tested positive – although about twice as frequently in the control colonies. Particularly noticeable is that infestation of the test colonies with the acute bee paralysis virus as a typical secondary infection of varroa tends to be lower. The results indicate that despite comparably high mite numbers, a reduction of the viral infestation in the colonies can be achieved with brood removal.

The right time

Brood removal can be effectively carried out before the natural swarming period commences until about mid-July. When done later, the share of removed mites drops and the regeneration of the colonies until start of winter could be jeopardised.

The optimal time mainly depends on the honey flow process. This is shown by the yield quantities of the Institute's test colonies treated at three different times (Illustration 2). Brood removal on May 20 (beginning of swarming period) resulted in significantly lower total yields of an average of 7.1 kg compared with an average of 21.5 kg of the control colonies. Brood removal on June 11 resulted in an average honey yield of 16.4 kg. The highest yield of an average of 27.3 kg was achieved by the colonies treated at the beginning of July, i.e. exactly 14 days prior to the final honey harvest. Due to the complete brood removal, their own requirements are significantly reduced while at first, their collection capacity remains virtually the same. The missing young bees only make themselves felt after the honey harvest.

For early and summer honey flow regions it can generally be recommended to carry out brood removal about 14 days prior to the last honey harvest. At that time, there is no risk of predators yet and sufficient time for the colonies to regenerate and "brood collectors" to develop into units capable of surviving winter.

As soon as the last honey has been harvested, the brood chamber that was restricted to one broos box in the course of brood removal is extended again and winter food provided. This ensures optimal winter bee rearing!

For late honey flow regions, however, the method appears to be less suitable. In this case, the alternative would be - depending on the honey flow process - an early brood removal that approximately corresponds with the swarm production of the hive beekeeping method used in the past. However, this presupposes that the colonies have about 6 – 8 weeks left after the removal until the expected honey flow.

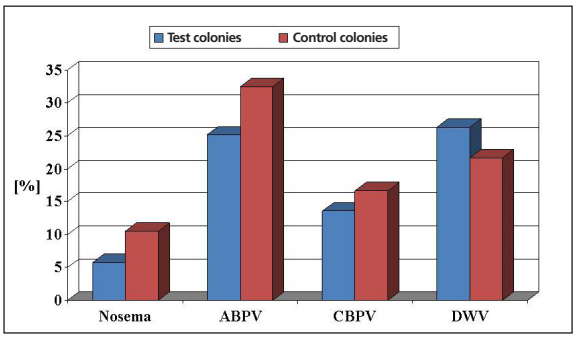

Illustration 1:
Infestation frequency of bee samples of both comparison groups with the pathogens of nosema, acute bee paralysis (ABPV), chronic bee paralysis (CBPV) and deformed wing virus (DWV).

Importance of economic thresholds of infestation

It must be considered with brood removal that there is always a certain remaining level of varroa infestation in the colonies and that reinfection may occur from diseased and poorly managed colonies in the surrounding area. Therefore, one should determine the actual level of bee infestation during winter bee rearing in the period of August/September based on bee samples. (See leaflet "Varroa unter Kontrolle" and/or Büchler et al: "Varroabefall richtig einschätzen" ADIZ/ db/ IF 07/2006, page 12 – 13). An immediate additional treatment is required if there are more than 5 mites/10g of bees. Particularly heavily infested colonies should be killed for the purpose of a responsible selection or – in case of a chemical treatment - the queen should be replaced by a more resistant line.

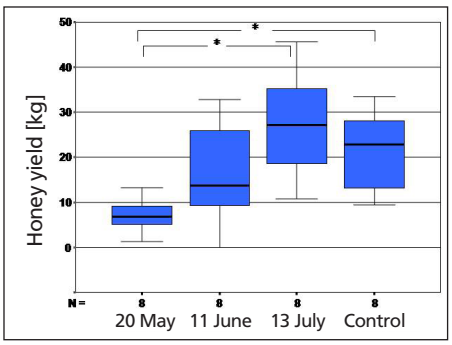

Illustration 2:
Honey yield 2008 in dependence on time of brood removal
* statistically significant difference ($p < 0.05$) between the respective groups.

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