

Biological cycle and behaviour of the european dark bee (*Apis mellifera mellifera*)

Translated from French at website <http://www.mellifica.be> by Graham WHITE

Introduction

The identification of the different races of bees depends on the study of morphology (biological form), which scientists call 'biometrics', which enables us to measure accurately the 'cubital index' of the wing, the colour and width of the tomentum (abdominal segments). Exact measurement of these physical features enables us to distinguish between the various races of bee within the species (*Apis mellifera mellifera*). We can clearly identify hybrid or cross-bred colonies, where the black bee has been mated with its near-relatives, such as the Italian Bee (*Apis mellifera ligustica*) or the Carniolan Bee (*Apis mellifera carnica*). These techniques are vital tools for identifying pure-bred black bees as opposed to cross-bred hybrids.

However, most beekeepers are far more interested in the growth of the colony and its honey crop, rather than in biometric measurements. This article explores some unique qualities of the black bee and shows how we can adapt our beekeeping practice to specifically manage colonies of black bees. For those who keep other varieties of bee, I hope to show that the European Black Bee can equally provide us with an enjoyable and profitable hobby.

In general this article deals only with the Black Bee found in Belgium between the Sambre-and-Meuse rivers. A down-loadable comprehensive document describes the ecological and cultural characteristics of the black bee (*Apis.mellifera. mellifera*) found in the South of Hainault and nearby areas.

1. Which kind of bee-keeping shall we practice?

Each beekeeper develops a system of practical management based on: the local environment, regional ecology (flora, climate, diseases etc.), the merits of the livestock (race/variety, productivity of stock, disease resistance etc.) and finally his own skills. If we focus on only one aspect or neglect the others, we can easily make mistakes in our bee management.

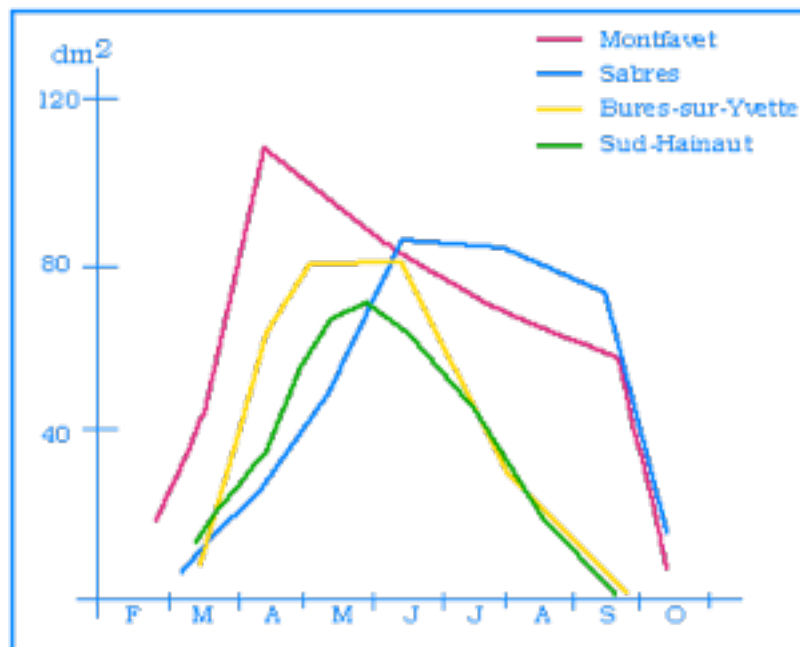
Most bee-keepers want better bees, more honey and maximum profit. I define profit as the difference between income and expenditure. This **practical** rule-of-thumb is often far-removed from the **theoretical** maximum which could be achieved by: greater expenditure of time, money and effort: through migratory beekeeping, selective breeding, stimulative feeding etc. However, the extra investment of money, time and effort is not always justified by the resulting honey harvest. Consequently, most people settle for an 'optimum' effort – where an averagely good harvest is produced for a 'reasonable' expenditure of time, effort and money.

This should give us food-for-thought and sets the background against which I wish to discuss the characteristics of the black bee.

2. Annual Development Cycle of the Brood-nest

The European Black Bee is divided into many eco-types or regional varieties; these regional sub-species and local varieties offer the beekeeper an astonishing variation in: the egg-laying cycle/rhythm of the queen and the annual cycle of the brood nest. Remarkably, this huge diversity of biology and behaviour seems to have hardly been explored, or exploited, in any selective breeding program.

The figure below shows the annual cycle-of-development of the brood nest, averaged in four different regions of Belgium. Spring-development of some colonies can appear a little slow, but other colonies develop very quickly in April, producing enough harvesters for the Spring honey-flow, which may come at the end of April, but more often with the beginning of May. The brood-nest begins to grow in the second half of February, but slowly at first.



Development Cycle of brood-nest for colonies of black bees in various areas (surfaces of brood-nest measured in square centimetres).

The data for Montfavet (Provence), Sabres (landes area, France) and Bures (Paris area) are drawn from Louveaux *et al.* (1966) the methods from the adaptation from the bees to the natural environment. *Annales de l'abeille*, 9 (4), 323-350. The data from South-Hainaut are taken from the observations of H. Guerriat

The brood-nest reaches its maximum size at the end of May, producing a peak-population of worker bees by the end of June, in time for the summer honey-flow. After this, the brood-nest shrinks in size and most of the bees turn their efforts to foraging for nectar rather than brood rearing; indeed, at the time of the main honey-flow, it is often difficult to find any young bees or nurse bees in the hive, which seems at times almost deserted. The black bee of our area (Chimay) is finely adapted to the summer honey-flow but it can also take advantage of good Spring harvests. It can even take advantage of later honey-flows at the end of July or in August, from heather, phacélie and sunflowers; however, some

other Belgian regional varieties of the black bee are even better adapted to exploit this late honey-flow.

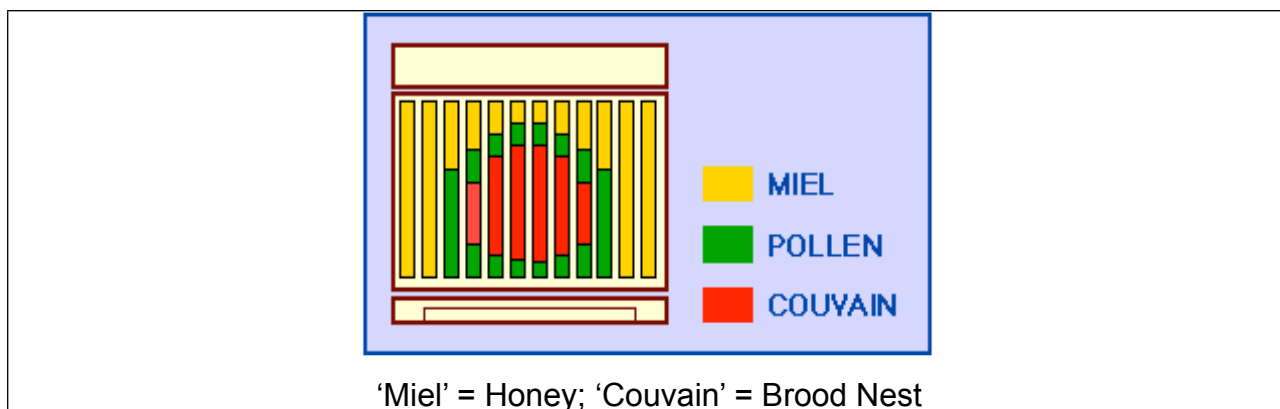
The persistence of brood late in the season varies enormously between different colonies and years. Generally, colonies do not enlarge the brood-nest beyond mid-August, but often, very small patches of active brood persist until the end of September. However, in general, the black bee prepares early for the coming winter by stopping brood-production and building winter stores.

The black bee is well adapted to the normal Spring and summer honey-flows in the sedentary apiary. In certain years, Spring-development of colonies is seen to be slow; in addition, populations are still growing during the Spring honey-flow and do not reach their peak in time for the beginning of this flow. One can overcome this disadvantage by limited modification of the brood-nest cycle: I propose a short stimulation-feed at the end of summer before winter-feeding but one must intervene very early. On the other hand, stimulation-feeding in early Spring seems to be a lot of effort for little benefit; the black bee does not respond well to this type of Spring-feeding stimulation.

A great variation in productivity is evident in colonies of black bees. By the end of May, colony brood-nests normally cover 8 or 9 Dadant frames; however these frames are never completely covered in brood. The hives which produce the most brood are generally hybrid colonies.

3. Organization and Structure of the Brood-Nest

The black bee arranges its brood-nest according to a traditional pattern with perfection. The brood-nest is wrapped in a layer of pollen, which in turn is surrounded by a layer of honey. The brood-nest is created in the centre of the hive wedged between two combs of pollen; beyond these pollen barriers, combs are filled entirely with honey.



The workers collect masses of pollen in Spring, especially when the willows bloom. The pollen-combs and the crowns of pollen above and below the brood-nest are well defined to begin with but they become blurred as the season advances. After the summer honey-flow, pollen harvesting starts again and black bees restore complete crowns of pollen around the brood nest, including at the bottom of the frames; this behaviour is less often seen in hybrid colonies.

The shape of the brood-nest and its position in the hive during winter varies according to the variety of bees. In our local area, the colony forms its winter-cluster near the hive entrance; the food stores are located above the winter-cluster and biased towards the rear of the hive. In Spring, the early brood-nest is also created near the hive entrance.



Brood Patch biased towards hive entrance

However, black queens from Savoy, which is a mountainous area, produce colonies with completely different behaviour from bees in our lowland areas. These mountain-colonies winter in the very centre of the hive, with food stored above the cluster, but also with stores placed in front of and to the rear of the cluster. In Spring, the brood-nest is created in the exact centre of the hive. This contrasting behaviour was also found in the F1 offspring (queen of Savoy X Between-Sambre-and-Meuse males) of these queens.



Savoy Brood Patch very central on combs

4. Hardiness

One of the great qualities of the black bee is its astonishing hardiness; a species is described as 'hardy' if it is strong, robust and needs little attention from the beekeeper. The hardiness of the black bee is founded on its biological-adaptation to the region where it evolved.

Any native-species is the result of thousands of years of evolution in a given environment. After thousands of generations of natural selection it will be finely adapted to the local environment: to the weather, seasonal temperatures, native flora, diseases and predators. Because of this an indigenous species is usually better able to survive local conditions and to respond to changes in the local environment than alien species, or varieties which are introduced from other regions. This is not to say that the indigenous bee is the 'best' bee for the beekeeper, since the objective of natural selection (the survival of the species) is quite different from that of the bee-keeper (maximum honey crop). Nevertheless, these evolutionary adaptations provide the native bee with specific biological advantages which the beekeeper should learn to notice, exploit and capitalise on through his management.

The black bee develops its brood-nest in a very special way that is quite different from other sub-species of *Apis Mellifera*. During bad weather development slows down and egg-laying may even stop completely if bad weather persists too long. However, the impact on the hive-population is limited because, when egg-laying is reduced, workers have less brood to take care of, less food is required, less work is needed and this increases the life-span of worker bees. I am always astonished by the strength of bee populations which persist, even after prolonged periods of bad weather and a reduction or stoppage of egg-laying. In sharp contrast, I have seen hybrid-colonies try to maintain a full brood-nest during a gap in the honey-flow and then die of starvation; such hybrids seem less able than the black bee to reduce their egg-laying during bad weather, and consequently need supplementary feeding. They are not able to adapt their behaviour to the weather as well as the black bee because they did not evolve in these climatic conditions.

In spite of the slow development of the brood nest, the black-bee develops quickly in Spring as early flowers become available, especially willow catkins which provide both pollen and nectar. Spring development of the brood-nest continues unchecked, whatever the date, as long as the colony has abundant pollen and nectar.

EVOLUTIONARY ADAPTATION EVIDENT IN MATING OF QUEENS

Another evolutionary adaptation is that the mating of queens is critically vulnerable in bad weather; it might be predicted that the black bee should be unable to thrive in some Northern areas because good weather cannot be guaranteed for virgin queens to be mated reliably. However, given the prevalence of prolonged bad Spring weather in Northern latitudes, the black bee has evolved and adapted to take immediate advantage of even a short improvement in the weather, to achieve a successful mating. Occasionally, virgin-queens have even been observed to mate in the immediate vicinity of the apiary itself if the weather is poor.. Other non-native species of bee seem less-able to take advantage of such short breaks in bad weather and may fail to mate successfully because they lack this evolutionary adaptation to bad weather.

5. Honey Harvest

During the years 1992-1996, the average honey harvest in Belgium rose to more than 25 kilos per hive, even in those areas which did not have oilseed-rape. The black bee is noted for its energetic work-rate and its strength of flight even in windy conditions; it flies very early in the morning during a honey-flow and works until late in the evening. It has been observed to collect pollen in wet weather, even during light rain, which testifies to this bee's weather-resistance. Once again these are specific evolutionary adaptations to local conditions, produced by natural selection over many thousands of generations.

The black bee tends to maximise its brood-rearing to exploit the main summer honey flow and then reduces brood production during the actual flow. Maintaining strong populations with a reduced brood-nest means less work within the hive and the longevity of bees increases – life-span lengthens; the colony consumes less food in raising brood, an economy which increases the harvest of honey.

The black bee stores honey close to the brood-nest. Rapid development in Spring fills the brood box with eggs and larvae, forcing the colony to store honey in the supers above. After mid-July, the brood-nest contracts and the bees tend not to store reserves in the

supers if the honey-flow slackens. This behaviour is extremely marked in certain genetic strains and explains the difficulty of exploiting late honey-flows with this bee.

6. Better Winter Survival

The black bee stops brood-development quite early in the autumn; the bee-keeper must provide winter food stores as soon as possible after the last harvest in order to allow colonies to prepare for the winter, and to benefit from late harvests of pollen. These stores are used for the development of wax, but also for storing food in the bottom of the frames, close to the bees and the hive entrance, where good ventilation reduces the risks of mouldy combs. All these behaviours enhance the black bee's **superior ability to survive winter** in our Northern climate. This quality in particular makes it possible to avoid the preventive treatments against nosema.

7. Less Tendency to Swarm

Swarming is much more frequent in the apiaries of hybridised or cross-bred black bees. A survey carried out by thirty bee-keepers in the Sambre-and-Meuse area over three years, concluded that 40 – 50% of all hybrid colonies swarm twice each year. This excessive rate of swarming accelerates when the native black bee is crossed with imported foreign races of bee. The swarming-rate is also increased because many bee-keepers do not re-queen their colonies as a matter of course each year. The experiment revealed that, in colonies of relatively pure black bees with young queens, the rate of swarming can be as low as 20% average. These results appear even better as they are obtained naturally, **without special intervention** of the bee-keeper (destruction of queen cells, for example). This remarkable behaviour of the black bee suggests we should investigate the relationship between the low-rate-of-swarming and the regular appearance of supersedure cells, rather than swarm cells, in pure black bee colonies. Several times, we have observed and marked two queens, living side by side, in a single colony; recently, at the end of March, two queens were found on the same day in a colony, both laying eggs.

8. Collecting pollen

The harvest of pollen is well adapted to the environment and characteristic of the various local varieties of black bee. A precise description is provided elsewhere on this site.



Baskets of pollen

9. Temperament

The main criticism often made against the black bee relates to its defensive or nervous temperament, which is said to be at-odds with modern bee-keeping. Critics condemn the black bee for running and jumping on the comb and for its aggressive behaviour. We should reflect on this however. To begin with, the 'better qualities' of the other races of bee are the fruit of extensive programmes of selective-breeding (e.g. Carnica, Buckfast, American strains etc.). Only very recently has any such long-term, methodical, selective breeding programme been tried with the European Black Bee. If we select queens for gentleness and calmness, we can reduce aggression and nervousness on the comb; indeed, these defects are no longer a problem in our own selectively-bred strains of black bee. The hybridization of wild and domestic colonies of native bees with foreign, imported varieties, is the main cause of these perceived defects and we have repeatedly observed an increase of aggressiveness and nervousness in hybrid colonies of black bees. Thus the 'bad reputation' of the European black bee is largely unjustified, since it is the genetic consequence of hybridising with other races of bee.

Conclusions

This article tries to give an outline of the behaviours which are most striking in the black bee. The bee-keeper should educate himself and adapt his apiary management to the specific biological characteristics of the black bee. Bee-keepers who do not have a great deal of time, who wish to minimise their interventions in colonies, and want a variety of bee that is easy to manage in a settled apiary, will find great satisfaction in beekeeping with their native black bee.



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