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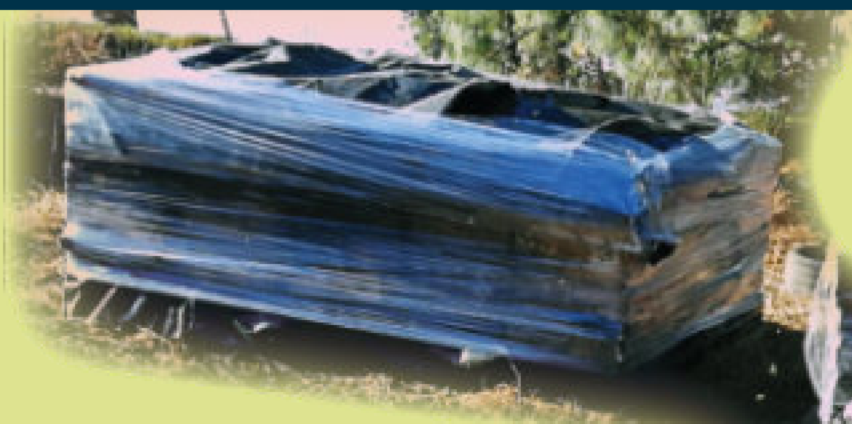

OVERVIEW OF THE BIOLOGY OF *CAPENSIS*

MIGRATORY BEEKEEPING AND THE *CAPENSIS* CALAMITY

RE-REGISTRATION OF BEEKEEPERS

REGULATION OF BEE PRODUCTS

agriculture, land reform & rural development
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Agriculture, Land Reform and Rural Development
REPUBLIC OF SOUTH AFRICA

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STARKE AYRES

STARKE AYRES SEEDS ARE BEE FRIENDLY!

Bees are very important in the production of vegetable plants as they pollinate flowers. Pollination is required for many garden vegetables such as some okra, beans, squash, cucumbers. Plants that are bee-friendly provide pollen and nectar to pollinators.

BEE FRIENDLY

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CONTENTS

Cover Image: Colonies infected with the capensis social parasite wrapped and prepared for gassing. **Image Credit:** Justin Thacker

SABIO is the official representative of the bee industry of South Africa. Its mission is to "represent and promote the interests of all persons involved in the beekeeping industry in South Africa in order to establish, support and develop an economically viable and sustainable apicultural sector and ensure the environmental security of the honey bee".

EDITORIAL

-*capensis* issue

After having devoted the previous issue of the journal to the impact of the COVID-19 pandemic on beekeeping both in South Africa and internationally, it is now appropriate to consider the impact of another parasite, but on this occasion one that is targeted at the bees themselves.

Discussions between SABIO and the Department of Agriculture, Land Reform and Rural Development (DALRRD) emphasised that there is a necessity to explain what is known about the *capensis* problem in South Africa. As a contribution to creating this document, DALRRD agreed to provide both some content for the issue as well as resources to produce it. The idea is to cover both the biology and the regulatory environment that relates to the "*capensis* problem".

In this issue we try to provide a clear picture of the biology of the subspecies of honey bee called *Apis mellifera capensis*. Understanding the biology of the subspecies is critical to understanding the nature of the problem that is being dealt with locally. In addition, critical to dispelling some widely circulating myths in relation to the various manifestations of *capensis* both as a sub-population of honey bees and as a clonal social parasite in the *scutellata* region. There is an interesting analogy between the *capensis* clone social parasite and the SARS-CoV-2 virus in that both reproduce asexually and hence produce offspring that are essentially a clone of their parental individual – this would be the equivalent of taking a human stem cell from an individual, then growing that cell into an adult human being. The offspring would be the clone of the individual from whom the stem cell was taken since they would share identical genetic material and no sexual reproduction is involved. This fanciful example is used, simply to make the point that in both SARS-CoV-2 and the *capensis* clone, the offspring produced are clones of the parental individual although the details of the genetic mechanism are very different.

The second element of the discussion regarding "the *capensis* problem" is that in order to deal with this matter, legislation was put in place to restrict the movement of colonies between the two populations of honey bees (see map p 5). The restriction on the movement of colonies has been put in place in order to ensure that the generation of a new parasitic clone is prevented. This restriction is similar to the ban on inter-provincial travel introduced in relation to COVID-19. The other important legislative requirement is to report colonies, outside of the *capensis* zone, that are infected with the *capensis* clone and to destroy the infected colonies.

The fact that there is abundant anecdotal evidence for the continued existence of the *capensis* clone in beekeepers' apiaries, but no formal reporting of the presence of the clone places the DALRRD in a difficult position since any proposed interventions or assistance to beekeepers needs to be based on primary data obtained through reporting, not on anecdotes provided by beekeepers. In order to address this problem from a regulatory point of view it is absolutely essential that the reporting and monitoring of the presence of the clone be made more systematic and regular. Only if this is done will the officials of DALRRD have the evidence that they require in order to ensure that resources are made available to address the problem. Dealing with a problem of this nature requires the development of a much more professional approach to beekeeping than has been evident in the past.

DALRRD is thanked for supporting the production of this issue of the journal in the interests of making it widely available beyond the membership of SABIO.

Robin M Crewe

Understanding "the *capensis* problem" and its consequences for beekeeping in South Africa

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The phenomenon known as "the *capensis* problem" or "the *capensis* calamity" in its current form has been a feature of the South African beekeeping landscape for a period of about 30 years. It has generated intense discussion, debate, myth making and legislation but does not appear to be very well understood. There have been earlier incarnations of the *capensis* problem but those appearances of a *capensis* infestation seem to have resolved themselves without any long term consequences (Johannsmeier, 1983). The current problem arose from the introduction of large numbers of *capensis* colonies into the *scutellata* region in 1990 by beekeepers. The consequences of these introductions were unexpected and have been persistent and need to be understood if a lasting solution to the social parasitism is to be found.

Subspecies of honey bees in South Africa

It is important to understand that there is only ONE species of honey bee (*Apis mellifera*) that is indigenous to the African continent. It has many subspecies in the different regions of the continent that are adapted to local environments (Hepburn and Radloff, 1998). South Africa has two well defined honey bee subspecies within its borders. Their distribution has been determined and shown on maps for a number of decades (Fig. 1) (Hepburn and Crewe, 1991).

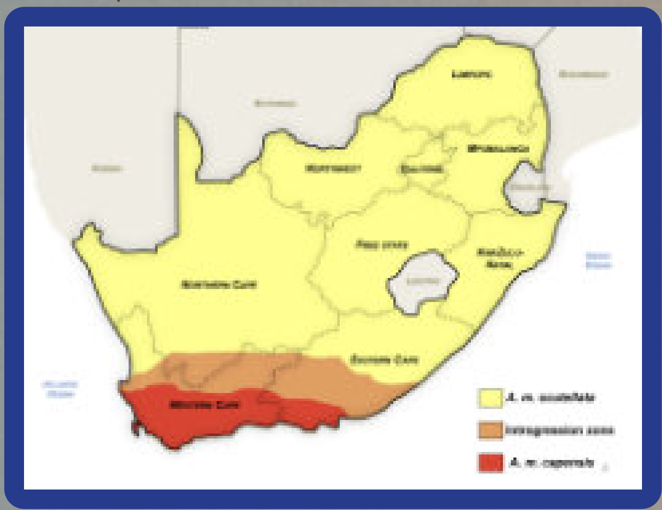

Fig. 1 – Geographic distribution of the two subspecies of honey bees in South Africa. The coloured regions on the map show the extent of each subspecies' distribution: red for A. m. *capensis*, yellow for *A. m. scutellata*. The area shaded in brown shows the region in which there is a transition between the characteristics of the one subspecies to the other. It is important to recognise that within these geographic regions the populations of honey bee colonies will consist of those in beekeepers apiaries and those in the wild population.

Characteristics of the two subspecies

The African honey bee or the savanna honey bee

The subspecies *A. m. scutellata*, which is sometimes called the African honey bee or the savanna honey bee, is widely distributed in eastern and southern Africa (Hepburn and Radloff, 1998), so it is indigenous but not endemic to South Africa and is the honey bee used for most beekeeping activities in the eastern and southern African region from Kenya in the north to the boundary with *capensis* in the south.

This subspecies of honey bee has biological characteristics that are not significantly different from those of other honey bee subspecies. They have colonies with a single queen who produces workers (females) from fertilised eggs and males (called drones) from unfertilised eggs. This means that workers and queens that are produced from fertilised eggs have two sets of chromosomes in each of their cells, while the drones which are produced from unfertilised eggs have only one set of chromosomes per cell. This form of sex determination means that females have mothers and fathers since they come from fertilised eggs, while males have only mothers since they are produced from unfertilised eggs laid by the queen. The other characteristic of these honey bees is the extent to which multiple mating takes place – in most cases, queens will have mated with between 20-70 drones and will store a sample of each drones' sperm in its spermatheca for use throughout the rest of its life. This mating system introduces a very significant degree of genetic diversity within each colony since the workers consist of a range of offspring which have the same mother (=queen) but individuals may have different fathers depending on which particular sperm was used to fertilise the egg from which they hatched.

When honey bee colonies have a well functioning queen (=queenright colonies), then the queen prevents the workers from reproducing. However, should a colony lose its queen (=queenless colony) and the workers are unsuccessful in rearing a replacement queen, then the workers in these hopelessly queenless colonies start completing amongst themselves for the opportunity to lay eggs. Since workers are anatomically incapable of mating with males and they do not visit drone congregation areas where drones mate with virgin queens, the only eggs that they are able to produce are those that are unfertilised. Thus queenless *scutellata* colonies may produce a small number of drones reared from worker laid eggs. Since these colonies are not producing any new workers, the colony dwindles in size and eventually dies.

The Cape honey bee

The subspecies *A. m. capensis* which is called the Cape honey bee, is indigenous to the fynbos biome of the south western region of South Africa (Fig 1) and is a uniquely endemic honey bee subspecies in South Africa. It is the honey bee subspecies on which all beekeeping activities in the Western Cape and its associated agricultural industries, depend.

This subspecies of honey bee has biological characteristics that are significantly different from those of all other honey bee subspecies. The unique character trait that they possess is that some of their workers are able to lay eggs that develop into females rather than males (Onions, 1911), which means that they lay eggs with two sets of chromosomes even though the eggs have not been fertilised by sperm. This novel form of reproduction in their workers has far reaching consequences for the colonies and for their interaction with other subspecies of honey bees.

They have colonies with a single queen who produces workers from fertilised eggs and males (called drones) from unfertilised eggs. This means that workers and queens that are produced from fertilised eggs that have two sets of chromosomes in each of their cells, while the drones which are produced from unfertilised eggs have only one set of chromosomes per cell. In this respect, the Cape honeybees are no different from other honey bee subspecies. Their queens also have high levels of multiple mating so the offspring in the colonies are highly diverse genetically.

When Cape honey bee colonies have a well functioning queen (=queenright colonies), then the queen prevents the workers from reproducing. However, as the queens age or should a colony lose its queen (=queenless colony), then workers start completing amongst themselves for the opportunity to lay eggs and they challenge the queen for the position of egglayer in the colony. A queenless *capensis* colony develops into one that is maintained by a small number of laying workers that are false queens (egg laying workers that produce pheromone signals that are the same as those of the queen) who have replaced the queen and produce eggs that give rise to females who become workers. Since the colony is producing female offspring it is able to sustain itself for a period of time and may even requeen itself from a worker laid egg (Anderson, 1963; Allsopp and Hepburn, 1997).

The unique characteristics of the Cape honey bee worker that are important for this story are the following:

1) They have larger numbers of ovarioles per ovary (10-40) than workers of other subspecies (0- 5). This means that they are capable of producing more eggs than other reproductive workers but are still nowhere near the queens (150-200 ovarioles/ovary) in reproductive capacity.

2) They activate their ovaries very rapidly which means that they are able to become reproductive within 2-3 days which is about half the time required for workers of other subspecies to become reproductive. (Fig. 2).

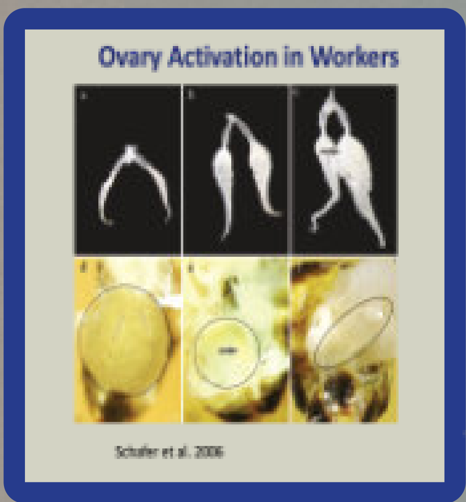

Fig 2. Ovary activation in laying workers with the ovarioles increasing in length and breadth and eggs developing.

3) The eggs that they lay have two sets of chromosomes and hence they develop into females -either queens (rarely) or workers. Since the two sets of chromosomes in the eggs come from the mother that laid them, the mother and the daughter have almost identical genetic material, making the daughter a clone of the mother. This form of reproduction is called thelytokous parthenogenesis.

4) The pheromones produced by these workers mimics that of the queens and they are able to alter the pheromone signal that they produce so that they are treated by other workers as though they are queens (= false queens) (Mumoki et al. 2019).

The "*capensis*" clone

It is important to recognise that the characteristics of the clonal *capensis* worker social parasites are distinct from those of colonies of the Cape honey bee. The *capensis* problem or what has been called 'the *capensis* calamity' (Allsopp, 1993) is a consequence of the introduction of large numbers of *capensis* colonies into the *scutellata* region in 1990. This particularly set of events was not the first time that *capensis* colonies had been translocated to areas where they are not normally found (Johannsmeier, 1983), but the results of this translocation where more dramatic and persistent than previous introductions had been.

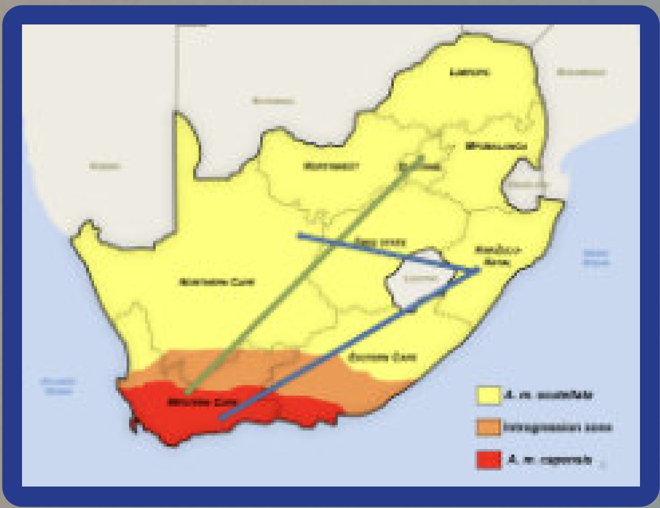

Fig. 3 – Two translocations of *capensis* colonies from 1) the Western Cape to KwaZulu-Natal and then to the Northern Cape and 2) the major translocation from the Western Cape to Gauteng. These translocations resulted in the establishment of a single clone of parasitic '*capensis*' workers that invaded the apiaries of beekeepers in the *scutellata* area.

After some intensive genetic investigation of the *capensis* parasitic workers that became established in *scutellata* apiaries after these translocation events, they were all found to be the offspring of a single worker (Kryger, 2001) that reproduced parthenogenetically and produced offspring that were highly infectious and were able to invade *scutellata* colonies and establish themselves as reproductives in those colonies. The *capensis* parasitic workers are genetically and reproductively isolated from all other honey bee subspecies and in our case all colonies of *capensis* and *scutellata* (Neumann et al. 2011).

The *capensis* social parasites or the *capensis* clone have all of the characteristics of other *capensis* workers that are listed above, but they are able to invade and replace the queens in the *scutellata* colonies that they gain access to. The process of invasion takes some weeks since the parasitic workers are not immediately able to replace the queen in a queenright colony. However, once the queen has disappeared, the parasitic workers replace her as the only reproductives in the colony and the host *scutellata* workers rear the parasitic worker offspring.

The colony transitions from being a *scutellata* colony to one that produces parasitic workers. During this transition, no further host *scutellata* workers are produced since their queen has been removed and the numbers of host workers start to dwindle as they age and die. The newly emerged parasitic workers do not undertake the tasks that young worker bees are normally engaged with such as brood care and then foraging, since their behaviour is directed to becoming reproductives. In the absence of brood care, the colony dwindles in size and the few remaining parasitic workers have to seek out a new colony to inflect in order to survive and produce their offspring. An apiary setting in which colonies are close together provides the ideal conditions for the transmission of the social parasites from infected colonies to the uninfected ones (Fig. 4).

The presence of any queenless colonies within an apiary represents a breach in the defensive wall of all of the colonies to invasion by the social parasite. The social parasites are able to enter queenless colonies with little resistance from host workers and rapidly establish themselves as the reproductives in these colonies with the resultant decline in the size of the worker population and the eventual death of the colony. The death of the colony is accompanied by the departure of the parasitic workers to find other colonies in which to be become established and begin the cycle of colony destruction again.

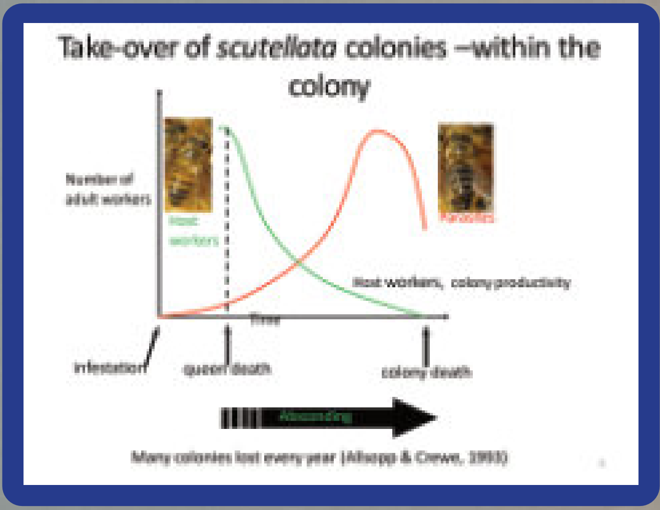

Fig 4. Diagram showing the events that take place when a host colony of *A. m. scutellata* is invaded by *capensis* parasitic workers from infestation to colony death.

In Fig. 5 the distribution of the *capensis* social parasite in the apiaries of beekeepers across the distribution area of *scutellata* colonies is shown. The important point about this map is that it emphasises that the social parasite is located in beekeepers colonies and is maintained in those colonies. It has not been detected in the wild population of honey bee colonies (Yusuf, A.A., pers. com). In view of this distribution of the social parasitic workers, their control could be achieved by eliminating the colonies and apiaries in which they occur. Indeed, the legislation that mandates the elimination of colonies that are infected by *capensis* social parasites, was directed to this objective. The question that beekeepers need to address is why this rather obvious solution was not successfully implemented and what prevents to from being implemented now?

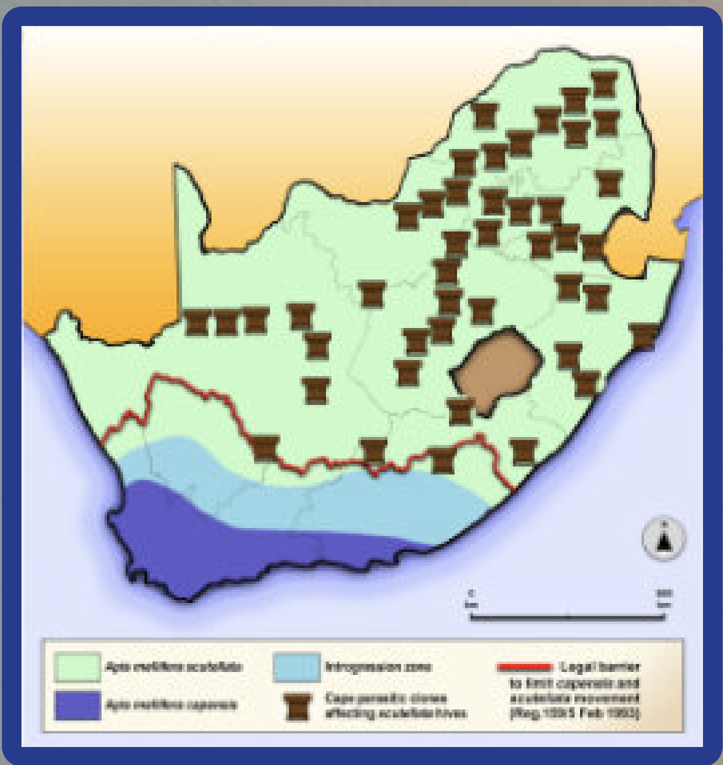

Fig 5. - Distribution of the two subspecies of Apis mellifera in South Africa over laid with the distribution of the *capensis* parasitic workers infecting the hives of apiaries marked on the map with bee hives. The parasite is not present in the wild population, but only in apiaries. The legal barrier to movement of colonies is indicated by the red line on the map.

The extent of the *capensis* problems

The nature of the *capensis* problem has been described previously by Dietemann, Lubbe and Crewe (2006), but the extent of the problem and its persistence has been tracked through the use of a number of surveys of beekeepers and provides a partial insight into the effects of the social parasite. The details of the surveys and their outcomes are presented in the article by Human and Pirk in this issue. The key element of these surveys is the evidence that the social parasite is the major factor (Fig. 6) in colonies losses in apiaries of beekeepers and that the extent of the problems has not declined over time despite legislation that requires the killing of colonies that are infected with the parasites.

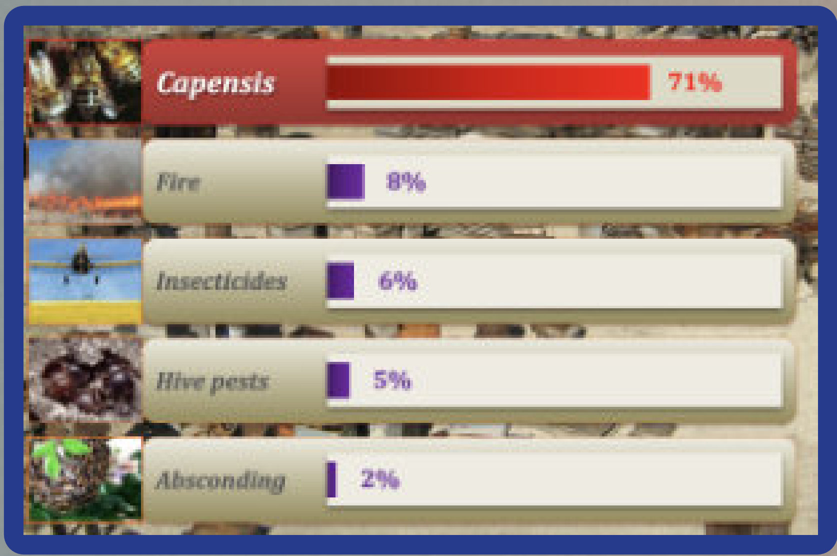

Fig. 6 – Factors contributing to colony losses in the *A. m. scutellata* area in 2014 from a survey of beekeepers

Conclusion

This overview has explored and laid out the biology of the two subspecies of honey bee present in South Africa and has distinguished them from the *capensis* parasitic workers that have caused beekeepers in the *scutellata* regions to suffer significant colony losses. In addition, these parasitic workers make routine queen rearing difficult and place additional stress on wild populations through the harvesting of swarms by beekeepers to replace colonies lost. How long the wild populations will continue to support this practice and at what scale is unknown. The wild populations are at risk of of overharvesting.

A concerted effort should be made by beekeepers and those responsible for the regulation of Agricultural activities to address this biological and regulatory problem. Should the current be allowed to persist, the ultimate calamity might be the collapse of beekeeping in the *scutellata* region.

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Can the *Capensis* clone problem be cured using static queen pheromone lures?

By:
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Facultative parasitism by a clonal lineage of the Cape honey bee *Apis mellifera capensis* in colonies of other subspecies especially those of *A. m. scutellata* has been the cause of extensive colony losses in South Africa. Recent surveys put these losses up to about 46% (Pirk et al. (2014) with most of these occurring in the *scutellata* region especially amongst migratory beekeepers. Losses of colonies happens when the clones gain entry into host *scutellata* colonies and take over reproduction through laying of eggs that produce worker offspring that do not contribute to or undertake housekeeping tasks within the colony. Subsequently these clone workers establish themselves as false-queens and are tended by the host's workers. Host workers neglect their own queen eventually resulting in a dwindling worker force, queen death and colony loss. The clone workers then seek another host colony to parasitize, thus continuing the cycle.

To date, the only viable management options for *capensis* clone infestations are reduced or temporarily halting migration into the *capensis* endemic zone, proper hive inspections after the migration of colonies, isolation and killing of infested hives.

From the time of the most recent "*capensis* problem" in the late 1990's to date, efforts have been put into better understanding the biology and unique behaviour of the clones as well as ways of preventing or eliminating the problem. There have been expectations of a biological or chemical cure to the problem. One possibility is the use of synthetic honey bee pheromones in host colonies that will ward off infesting clones and provide protection to uninfected colonies.

To test whether using synthetic queen pheromones can cure or prevent clone infestations, we undertook experiments in an apiary using eight randomly selected colonies infested with *capensis* clones and four colonies that were not infested. In four of the clone infected and four of *scutellata* uninfected colonies we placed one Beeboost®strip (plastic stripes containing queen pheromone, Fig 1A) each onto the frame in the centre (Fig 1B). We left the other four clone infested colonies untreated with no Beeboost® stripes inserted in them. Clone infestation was determined using the characteristics outlined in Dietemann et al. (2006) which include the following: presence of multiple eggs, patchy and irregular brood patterns, raised capping on worker brood, presence of black bees, docile behaviour of infested colonies and the presence or absence of queen. Colonies were thereafter monitored for 17 weeks (4 months) inspected at week 1, week 2, week 5, week 9 and week 17 respectively. We also monitored the colonies for any re-queening attempts by observing and noting the presence or absence of queen cells during the experimental period.

Fig. 1 Synthetic pheromone lure (Beeboost®) in yellow plastic tubes (A) and the synthetic lure suspended on a frame (B).

A

B

Five weeks after treatment, only one of the *capensis* infested colonies had been lost (Fig 2). By the ninth week of treatment three, (75%) of *capensis* clone infested colonies treated with Beeboost® were lost in comparison to one (25%) of untreated *capensis* infested colonies and none of the *scutellata* colonies treated with the Beeboost® (Fig 2). All *capensis* infested colonies irrespective of their treatment were lost by week 17 while only one *scutellata* colony was lost (Fig 2). We observed re-queening efforts only in clone infested colonies irrespective of whether they were treated or not (Table 1).

Table 1. Re-queening efforts by colonies during the experimental period

	Week 1	Week 2	Week 5	Week 9	Week 17
Scutellata Tr	0	0	0	0	0
Clones C	0	2	2	2	0
Clones Tr	0	2	1	2	0

Scutellata Tr = *A. m. scutellata* colonies treated with Beeboost, Clones C = clone infested colonies not treated with Beeboost and Clones TR = clone infested colonies treated with Beeboost.

Our results show that treating colonies with queen pheromones does not assist in anyway with controlling or protecting them from clone infestations. Rather, it speeds up colony loss and destabilises hierarchies by introducing an additional queen pheromonal source into the hive. It also does not assist in re-queening, as all attempts in these colonies were unsuccessful. Interestingly, queen cells were only present in clone infested colonies and not in uninfected *A. m. scutellata* colonies thus confirming that colonies do make efforts to recover from infestations even though it is always is a lost battle. Probable reasons why the pheromone dispensers did not work as a prospective cure for clone infestation include the fact that the lure is stationary while the queen moves and can spread her pheromones in the hive easily. Previously, we have shown in laboratory caged experiments that worker bees (mobile pheromone carriers) carrying either a synthetic pheromone or extract of pheromones can be turned into false-queens producing queen-like pheromones, attracting retinues and developing their ovaries (Yusuf et al., 2018). Furthermore, the fact that the synthetic pheromones were made based on the composition of queen pheromone signals from European sub-species, that are different from those of African sub-species (Crewe, 1982) may be a further factor in their ineffectiveness.

In conclusion, our results did confirmed that earlier suggestions of finding a probable biological or chemical cure for the *capensis* clone problem at least through the use of pheromones was a cul-de-sac, even though it seemed plausible based on pheromones being one of the main weapons used by the clones to infest host colonies. This is not surprising as infestations by *capensis* are anthropogenically driven and sustained by beekeeping practices. Hence, the solution to the *capensis* problem remains in practicing sustainable beekeeping as the current beekeeping practices maintain and spread the parasites.

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REPUBLIC OF SOUTH AFRICA

REGULATIONS FOR THE SALE OF HONEY AND BEE PRODUCTS IN SOUTH AFRICA

Are you intending to sell honey and mixtures of bee products in South Africa?

The Department of Agriculture, Land Reform and Rural Development (DALRRD) is urging all the producers, packers and importers of honey or mixtures of bee products in South Africa to comply with the regulations relating to the grading, packing and marking of honey or a mixture of bee products. Compliance with the requirements of the relevant regulations is quite instrumental to enhancing market access for smallholder and commercial beekeepers and or processors.

The sale of honey and mixtures of bee products is regulated in terms of the Agricultural Product Standards Act, 1990 (Act No. 119 of 1990), Regulation No. R.835 dated 25 August 2000. The regulation prescribes that honey and mixtures of bee products shall comply with the key elements which include, among others, grading, packing and marking requirements. Producers, packers and importers of honey and mixtures of bee products are advised to comply with the local market requirements enshrined in the Agricultural Product Standards Act, 1990 (Act No. 119 of 1990) and its regulations in order to produce good quality honey and mixtures of bee products that can compete in the formal markets. Food safety and quality measures should be a priority in all honey and mixtures of bee products producers/ packers and importers.

It is important to note that honey may be subjected to laboratory tests to determine the composition, quality and ripeness. If the honey does not comply with any one of these selected tests, then it shall be deemed as not complying with standards for grades of honey. The ability to comply is quite instrumental to the attainment of, among others, the objectives of the National Development Plan and the Agricultural Policy Action Plan relative to fighting unemployment, alleviating poverty, ensuring economic growth and positioning South Africa in the world through marketing and supplying the world with honey and mixtures of bee products that meet market requirements, i.e. marked and packaged properly, good quality and healthy and safe for human consumption.

The apiculture industry plays an important role in generating employment and in increasing family income. Amid the complexities in the apiculture industry, like many developing countries, South Africa is striving to improve the quality of the honey and mixtures of bee products. Amongst the challenges in question, control of regulated diseases and pests of honey bees has been one of the fundamental priorities. American foul brood is currently a challenge to certain parts of the Western Cape Province resulting in major economic damage to the industry. In essence, Good Agricultural Practices and Good Manufacturing Practices are critical in order to sustain this crucial industry.

As part of preventing and minimizing the potential introduction of exotic pests of honey bees, it is crucial that imported honey and mixtures of bee products must comply with the import conditions as stipulated by the Agricultural Pests Act, 1983 (Act No. 36 of 1983) of the DAFF and applicable food safety requirements as prescribed by the Foodstuffs, Cosmetics and Disinfectant Act, 1972 (Act No. 54 of 1972) of the Department of Health. An Import Permit is required to import honey and mixtures of bee products into the Republic of South Africa, and it can be obtained from DALRRD.

For further information on please contact the Directorate: Food Import and Export Standards Tel: 012 319 6118 / 6295, Email: MphoS@dalrrd.gov.za
The requirements for the labelling of honey and bee products are indicated in Fig. 1.

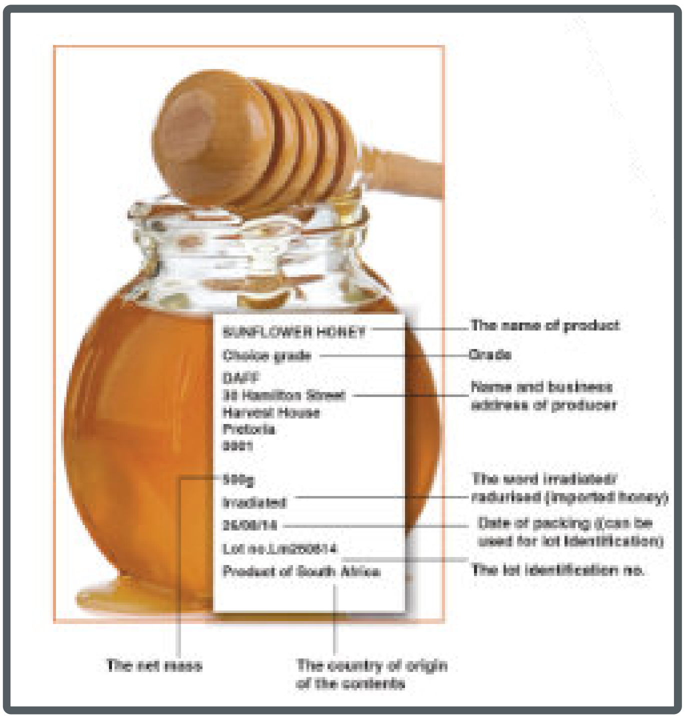


Fig 1. Requirements for the labelling of honey and honey products. Please note the elements that must be present on the label.

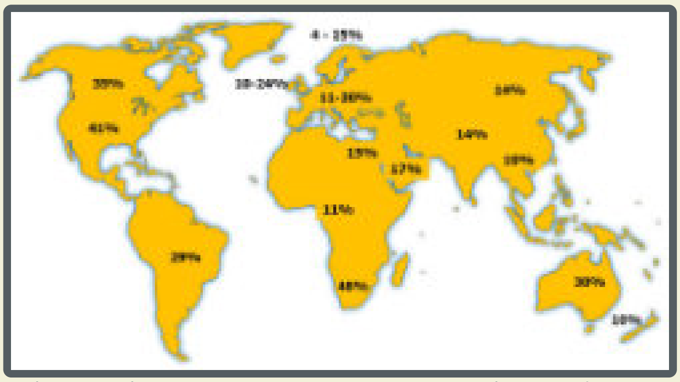
Migratory beekeeping sustains the ‘*Capensis* calamity’

By: C W W Pirk, and H Human

Social Insects Research Group, Department of Zoology and Entomology, University of Pretoria, Pretoria, South Africa.

Agriculture, in particular commercial crop production, relies heavily on pollination services of the Western honeybees (*Apis mellifera* L.) and even more so on managed colonies. The global concern about honeybee declines have resulted in greater awareness about the importance of pollination and attempts to protect all pollinators (Biesmeijer et al 2006, Kevan and Phillips 2001). Despite a lack of reports of exceptional losses in South Africa, Pirk et al (2014) found that migratory beekeepers suffered significantly higher colony losses in this country than elsewhere. Migratory beekeeping is a high-risk beekeeping practise, with the movement of colonies over distance, sometimes into areas with high colony densities that aid in the transmission of parasites e.g. *capensis* social parasites Dietemann et al (2006).

Figure 1 Global colony losses as reported by COLOSS (https://coloss.org/) in 2019



Both indigenous honeybee subspecies, *Apis mellifera capensis* (Cape honeybee) and *A. m. scutellata* (savannah honeybee), are used for crop pollination (Hepburn and Radloff 1998) and face the same pathogens and diseases. However, *A. m. scutellata* bees have an additional stressor namely the *capensis* social parasite (Neumann and Hepburn 2002). Migratory beekeeping spreads the *capensis* parasite throughout the summer rainfall region (Allsopp 1993). Despite legislation (Agricultural Pests Act, 1983 (Act no 36 of 1983) and the Control Measures Relating to Honey Bees, Regulation 1151 of 22 November 2019) that banned movement of Cape honeybees into the Savannah honeybee region and control measures e.g. the mandatory killing of infected colonies within 72 hours after observation (Lubbe 2005), the so called ‘*capensis* calamity’ still persists after 30 years.

We have been investigating colony losses in South Africa since 2009 through annual questionnaires to all commercial, small scale and hobbyist beekeepers. This aim was to determine the extent of colony losses in the country and the main perceived reasons thereof. In this article we want to highlight the losses as a result of the *capensis* social parasite in relation to migratory beekeeping in the summer rainfall areas of South Africa.

Figure 2 Colony losses by migratory and non-migratory beekeeping practises for the period 2009 - 2015.

Focusing on operations using *A. m. scutellata*, migratory beekeeping operations experienced significantly higher losses compared to those of non-migratory beekeepers. The first worrying part is that migratory beekeepers had at least double the number of loses compared with non -migratory beekeepers (Fig 2); second, the majority of these loses where attributed to the *capensis* clone (Table

1). When one looks at the enhancement of losses due to the presence of the *capensis* clone (Table 1), it is clear that more than 60% of losses in any given year was perceived to be caused by *capensis*. Migratory beekeepers lost more colonies to *capensis* alone than the non-migratory beekeepers did to all causes together. It appears that these losses have occurred and have not been reported to the Regulatory body (DALRRD) as is required by the regulations.

Table 1 : Results of the survey of beekeepers who provided information about colony losses. The percentage of colonies lost to all causes is given, together with percentage of losses attributed to *capensis* infections, followed by the percentage that *capensis* loss contribute to total loss.

	2009/2010	2011/2012	2013/2014	2014/2015
Percentage colonies lost	50.2%	50.3%	71.8%	60.4%
Percentage loss due to *capensis* infection	31.1%	37.4%	57.2%	42.7%
Relative *capensis* damage (in %) of losses	63.8%	74.3%	79.7%	70.6%

The fact that *A. m. scutellata* colony losses continue to occur, is reason for concern. This is clearly a case where the problem continues to exist because of beekeeping practises and the transmission of the *capensis* social parasite associated with these practises. The proportion of losses due to the presence of the *capensis* social parasite has varied from a low of 63.8% to a high of 79.7% showing that it is by far the most serious contributor to colony losses. The question arises if these continued losses over the last decade are sustainable at all or if we have a looming pollinator crisis on the horizon.

The results of the survey clearly indicate that the manner in bees are kept and used, influences the number of colonies being lost, therefore adapting management practises should hold the key to the problem. With the increasing demand for pollination services, the potential crisis could be avoided by practising sustainable beekeeping and good management. Furthermore, cases should be report to DALRRD so that policy makers and politicians become aware of the situation and can be motivate to address the crisis. It is time to deal decisively with the presence of the *capensis* social parasite so that this single largest source of colony losses can be eliminated.

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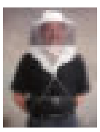

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Registration for Beekeepers

Registration of beekeepers in terms of the Agricultural Pests Act, 1983 (Act No. 36 of 1983)

In terms of the Agricultural Pests Act, 1983 (Act No.36 of 1983) Control Measures R.858 of 15 November 2013, as amended by R. 1511 of 22 November 2019 all beekeepers are required to register their beekeeping activities. The purpose of the registration is to ensure effective control and management of bee disease as well as the *capensis* problem. The regulation encourages any person who keeps, owns, or is in charge of a colony of honey-bees, whether for commercial purposes, a hobbyist or as a bee removal service provider to register as a beekeeper with the Department of Agriculture, Land Reform and Rural Development (DALRRD, Directorate Inspection Services.

Registration process:

- All beekeepers shall register with the DALRRD at anytime of the year and the validity of the registration will be for 24 months from the date of registration.
- An applicant shall, on the form obtainable from the executive officer furnish the Department with his/her personal details, that will include the name, type of operation, addresses (both physical and postal), contact details and any other information that may be requested on the form.
- On initial registration, a beekeeper will be assigned a permanent registration number by the Department.
- The beekeeper shall inform the Department within a reasonable period of time of any changes in the personal information provided for registration purposes.
- In the case of failure to comply with registration procedures, a registered beekeeper shall be deregistered and shall face penalties in terms of the Act.
- All beekeepers shall keep written records of the number of colonies kept, location of every apiary, presence of any American foulbrood disease and management measures used for control. It is important to note that, the executive officer may request a beekeeper to furnish additional records to the Department for disease control purposes.
- The beekeeper shall notify the Department in the event that he ceases to carry out beekeeping activities.

Beekeepers registration form can be accessed on: https://www.dalrrd.gov.za/Branches/Agricultural-Production-Health-Food-Safety/Inspection-Services/Beekeepers

For beekeeper registration contact:

Directorate: Inspection Services,

Tel.: 012 309 8739/8763/8780,

Cell: 066 299 5343,

Fax no.: 012 309 8789,

E-mail: Registrations@dalrrd.gov.za

Symptoms of a *capensis* Infected Colony

By: R M Crewe

Many beekeepers are not sure how they should determine whether one of their *scutellata* colonies has been inflected by workers of the *capensis* social parasite. The following information is provided so that beekeepers can make an informed decision about the status of their hives.

1) Presence of dark bees in the colony (Fig 1).

The presence of worker bees with a uniformly black abdomen and in some cases with individuals that have had the hairs removed from the abdomen giving it a shiny appearance.
Caution: Colour is not a very reliable indicator of a *capensis* infection, but if you notice dark bees then explore for further symptoms.

Fig. 1 A worker bee with a black abdomen that may indicate that the colony has been infected by the *capensis* worker parasites.

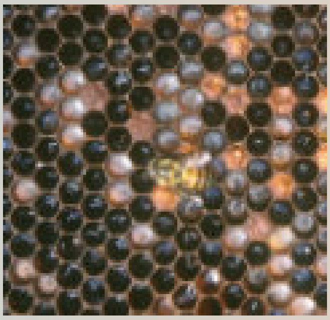
2) Presence of multiple eggs in both worker cells and in queen cells (Fig 2).

Multiple eggs in cells is characteristic of all laying workers both those from *capensis* colonies and those from *scutellata* colonies. The presence of these multiple eggs in the cells is an indication that laying workers are present.

Fig. 2 Multiple eggs laid in worker cells on the left and multiple eggs in a queen cell on the right.

3) The pattern of the brood on the comb becomes irregular and has a spotted appearance (Fig 3).

This arises because the queen is no longer laying eggs and the regular brood pattern is disrupted.



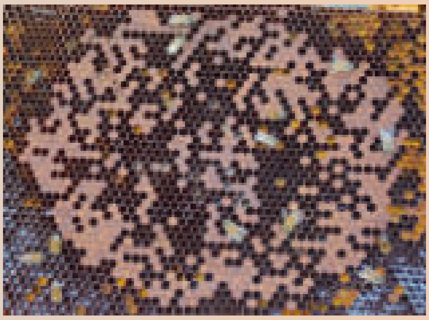


Fig. 3 The typical scattered brood pattern of an inflected colony is shown on the right, while the scattered brood pattern with multiple eggs in a cell are shown on the left.

4) Cappings of brood cells of *capensis* parasitic laying workers are often raised.

These raised cell cappings should not be confused with the raised cappings of drone cells which are higher and the cells usually larger than the cells in which workers are raised (Fig. 4).

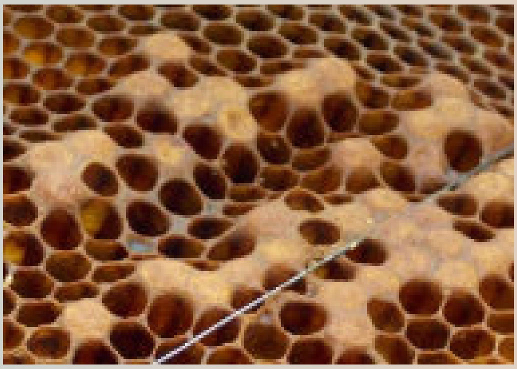


Fig. 4 Two examples of raised cappings on the brood cells of combs where *capensis* laying worker brood is being reared.

5) Wings held at an angle from the body (Fig 5).

The *capensis* laying workers can sometimes be recognised on the comb since they hold their wings at an angle from the body rather than folded over the body. Workers on the comb normally have the wings folded over the body.

Fig. 5 A *capensis* laying worker on a comb with the wings held at an angle away from the body.

6) Laying worker with swollen abdomen. (Fig 6).

Since the *capensis* laying workers have activated ovaries in which eggs are developing, the abdomen becomes somewhat swollen.

Fig. 6 Dark *capensis* laying worker with enlarged abdomen in centre of the picture.

7) Formation of a retinue around the laying worker or attraction to the laying workers.

Capensis laying workers are able to change the pheromone produced by the mandibular gland so that it mimics that of a queen. The release of this pheromone ensures that the laying workers are preferentially fed by the host workers, the host workers recognise them as queens and often form a retinue around them (Fig. 7). These laying workers are referred to as false queens since although they are workers they produce queen pheromones and lay eggs.

Fig. 7 Diagram of the formation of a retinue of *scutellata* host workers around a *capensis* false queen.

How to use the symptoms to confirm a *capensis* laying worker infection

Inspect the brood frames of the suspect colony carefully and make a note of the symptoms that you can identify. If 5 or more of the symptoms are present then the colony is considered to be infected and needs to be destroyed.

Actions on the Identification of Infected Colonies

The *capensis* social parasite is regulated under the Agricultural Pests Act, 1983 (Act no 36 of 1983) and the Control Measures Relating to Honey Bees, Regulation 1151 of 22 November 2019.

When infected colonies are identified using the symptoms described above, what is the beekeeper expected to do?

The following steps should be taken:

- By law, beekeepers are required to kill infected colonies (see cover picture)
- Report the presence of infected colonies to the DALRRD inspectors: Kobus Kemp kobusk@dalrrd.gov.za or Riaan van Zyl – riaanvz@dalrrd.gov.za

The advice of the inspectors is that:

- Colonies should be inspected regularly for the capensis social parasite. Proper records should be kept of each colony.
- Begin inspections in apiaries where the colonies have been used for commercial pollination and/or taken to a nectar flow shared with other beekeepers.
- Inspect colonies in apiaries in areas known or suspected to have infections of capensis laying workers.

When an infection is suspected then:

- Remove any suspect colonies from the apiary.
- Place these colonies in quarantine
- If the symptoms in the colony become more severe after two weeks, the colony must be killed as described below.
- If the capensis infection is confirmed at any point in this process, kill the colony at night after all the field bees have returned to the colony.

It is important that colonies be inspected regularly for the presence of the *capensis* social parasite. Colonies should only be marked for elimination when the infection has been positively identified using the symptoms described above.

SABIO ANNUAL GENERAL MEETING SATURDAY, 28 NOVEMBER 2020.

NOTICE IS HEREBY GIVEN FOR THE CONVENING OF THE EIGHTEENTH ANNUAL GENERAL MEETING OF THE SOUTH AFRICAN BEE INDUSTRY ASSOCIATION (SABIO) TO BE HELD AS FOLLOWS:

28th November 2020
Meeting venue to be announced
Host region: Gauteng

Members in good standing are invited to nominate members to serve on the SABIO Board of Directors. Seven vacancies need to be filled due SABIO's rotation policy as well as an increase in the number of Board members.

The following documents were sent to members by email:

1. Minutes of the 17th Annual General Meeting held during July 2019.
2. Notice of convening the 18th Annual General Meeting.
3. Call for nominations of Board Members. Closing of nominations strictly close of business, Friday 23 October 2020.
4. Proposed amendments to the SABIO constitution. You are welcome to send comments for consideration in preparing the final submission for ratifying at the Annual General Meeting.
5. Honey competition entry form.
6. Honey competition invite.

Closing of nominations for the Board, annotated items for the agenda as well as comments on the proposed Constitutional Changes shall be strictly close of business, Friday 23 October 2020.

Final documents shall be submitted first week of November 2020, including:

a. Final Agenda for the 18th Annual General Meeting.
b. Changes to the Constitution – final draft proposal.
c. Audited Financial Statements 2019/20.
d. Call for Nominations Beekeeper of the Year.

We look forward to your participation.

Regards

Adriaan du Toit (Ph.D.)
Chairman SABIO Board of Directors
083 306 1446
adriaandt@sabio.org.za

Papers of Interest

In this section of the journal, we generally try to bring readers attention to interesting articles that have been published recent and are of interest to practical beekeepers. We have also been asked to provide historically important papers on occasions. Since this is the issue devoted to understanding *capensis*, it is important to draw attention to a contribution made by Martin Johannsmeier in the journal in 1983.

Johannsmeier, J. (1983). Experiences with the Cape Bee in the Transvaal. SA Bee J. 55: 130-138.

Experiences with the Cape bee in the Transvaal

M. F. Johannsmeier, Government Apiary, Pretoria.

The article describes the consequences of experiments that were carried out with *A. m. capensis* colonies during the period 1976-1979 at the Government Apiary on the University of Pretoria experimental farm in Hatfield, Pretoria. The experiments were designed to study the laying workers produced in these colonies and to measure their influence on queen rearing in the colony.

A result of these experiments was that colonies of *A. m. scutellata* (called *adansonii in the paper*) were invaded by *capensis* workers causing queen losses and the decline of the colonies. The problem persisted for two years even though the infected colonies were gassed and was solved only when all the colonies in the apiary were gassed, and new *scutellata* colonies obtained to reestablish the apiary. The introduction to the paper contains the following warning which was to be a prophetic one some ten years later -

"An account is nevertheless given of experiences with Cape bees to illustrate the impact laying workers can have on an *adansonii* apiary and to warn beekeepers against the introduction of Cape bees into apiaries of other bee races."

The paper deals in detail with the interaction between Cape honey bees and the bees in *scutellata* colonies. It also details the introduction of Cape honey bee colonies into Pretoria (1927 & 1976), Pietermaritzburg (1975), and Molepolole, Botswana (± 1978) with invasions by laying workers into local colonies but none of the introductions became established. The key message of this paper was -

The problem, however lies in the Cape laying workers that invade *adansonii* colonies, which leads to queenlessness, dwindling and absconding. In an *adansonii* apiary "ideal" conditions exist for the survival of Cape laying workers, because colonies in which the parthenogenetic reproduction can take place, are always available. This kind of reproduction involves no drones, is self perpetuating and there is no gene loss. This condition could probably persist for five to ten years or even longer in an *adansonii* apiary, unless drastic measures are taken to eliminate the Cape bees from such an apiary.

The comments contained in the quotation above remain true to the current time and show how accurate Martin Johannsmeier was in describing the consequences of a Cape bee infection. He would likely be a little surprised that the 1990 introduction would persist for more than 30 years.

Effectiveness of honey for symptomatic relief in upper respiratory tract infections: a systematic review and meta-analysis

Hibatullah Abuelgasim ,[1] Charlotte Albury,[2] Joseph Lee[2]

10.1136/bmjebm-2020-111336

► Additional material is published online only. To view please visit the journal online (http://dx.doi.org/10.1136/bmjebm-2020-111336).

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Abstract

Background Antibiotic over prescription for upper respiratory tract infections (URTIs) in primary care exacerbates antimicrobial resistance. There is a need for effective alternatives to antibiotic prescribing. Honey is a lay remedy for URTIs, and has an emerging evidence base for its use. Honey has antimicrobial properties, and guidelines recommended honey for acute cough in children.

Objectives To evaluate the effectiveness of honey for symptomatic relief in URTIs.

Methods A systematic review and meta-analysis. We searched Pubmed, Embase, Web of Science, AMED, Cab abstracts, Cochrane Library, LILACS, and CINAHL with a combination of keywords and MeSH terms.

Results We identified 1345 unique records, and 14 studies were included. Overall risk of bias was moderate. Compared with usual care, honey improved combined symptom score (three studies, mean difference −3.96, 95% CI −5.42 to −2.51, I^2=0%), cough frequency (eight studies, standardised mean difference (SMD) −0.36, 95% CI −0.50 to −0.21, I^2=0%) and cough severity (five studies, SMD −0.44, 95% CI −0.64 to −0.25, I^2=20%). We combined two studies comparing honey with placebo for relieving combined symptoms (SMD −0.63, 95% CI −1.44 to 0.18, I^2=91%).

Conclusions Honey was superior to usual care for the improvement of symptoms of upper respiratory tract infections. It provides a widely available and cheap alternative to antibiotics. Honey could help efforts to slow the spread of antimicrobial resistance, but further high quality, placebo controlled trials are needed.

PROSPERO registration No Study ID, CRD42017067582 on PROSPERO: International prospective register of systematic reviews (https://www.crd.york.ac.uk/prospero/).

Summary box

What is already known about this subject?

- Honey is a well known lay therapy for symptoms of upper respiratory tract infections (URTIs); other medications for URTIs are ineffective and can have harmful side effects
- The use of antibiotics for URTIs is a particular problem, because they are ineffective, and contribute to antimicrobial resistance
- A Cochrane systematic review found that honey can improve cough in children; honey has not been systematically reviewed for other URTI symptoms, or in other patient groups

What are the new findings?

- Honey is more effective than usual care alternatives for improving URTI symptoms, particularly cough frequency and cough severity
- Comparisons with placebo are more limited, and require more high quality, placebo controlled trials

How might it impact on clinical practice in the foreseeable future?

- There are currently very few effective options that clinicians can prescribe for URTIs
- Honey can be used as an alternative to antibiotics by clinicians who wish to offer treatment for URTIs, which may help to combat antimicrobial resistance

To cite: Abuelgasim H, Albury C, Lee J. *BMJ Evidence-Based Medicine* Epub ahead of print: [please include Day Month Year]. doi:10.1136/bmjebm-2020-111336

Introduction

Upper respiratory tract infections (URTIs) are the most frequent reason for antibiotic prescription.[1] Since the majority of URTIs are viral, antibiotic prescription is both ineffective[2,3] and inappropriate.[4] However, a lack of effective alternatives, as well as a desire to preserve the patient–doctor relationship, both contribute to antibiotic over prescription.[5,6] Antibiotic overuse is a key driver of antimicrobial resistance,[7] rated by the UK government as one of the top 10 risks facing Britain.[8] Furthermore, drug resistant infections are associated with worse patient outcomes than antibiotic susceptible infections,[9] underlining the impact of antimicrobial resistance on individual patients.

Honey is a well known traditional therapy for URTI symptoms. Guidelines recommend it for acute cough in children[10] but the evidence base for honey use for other URTI symptoms and populations has not been evaluated. We therefore systematically reviewed the use of honey for the

ANNUAL REVIEWS

Annual Review of Entomology

Honey as a Functional Food for *Apis mellifera*

May R. Berenbaum and Bernarda Calla

Department of Entomology, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801, USA; email: maybe@illinois.edu

Annu. Rev. Entomol. 2021. 66:9.1–9.24

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Keywords

antioxidants, flavonoids, phenolics, detoxification, immunity, alpha-glucosidases, invertase

Abstract

Although nectar is consumed, primarily as a supplemental food, by a broad range of insects spanning at least five orders, it is processed and stored by only a small number of species, most of which are bees and wasps in the superfamily Apoidea. Within this group, *Apis mellifera* has evolved remarkable adaptations facilitating nectar processing and storage; in doing so, this species utilizes the end product, honey, for diverse functions with few if any equivalents in other phytophagous insects. Honey and its phytochemical constituents, some of which likely derive from propolis, have functional significance in protecting honey bees against microbial pathogens, toxins, and cold stress, as well as in regulating development and adult longevity. The distinctive properties of *A. mellifera* honey appear to have arisen in multiple ways, including genome modification; partnerships with microbial symbionts; and evolution of specialized behaviors, including foraging for substances other than nectar. That honey making by *A. mellifera* involves incorporation of exogenous material other than nectar, as well as endogenous products such as antimicrobial peptides and royal jelly, suggests that regarding honey as little more than a source of carbohydrates for bees is a concept in need of revision.

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