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Beekeeping techniques

Recent research on swarm control

In comparison with the history of beekeeping itself, all methods of swarm control in the current sense—swarm *prevention*—are recent. Not much more than a hundred years ago swarm control was concerned mainly with controlling the time at which the swarms issued, and in catching and housing the swarms[1].

Methods designed for swarm prevention can conveniently be grouped under either apiary management or colony manipulation. Under *apiary management* are included hive size and shape, strain of bee, and general seasonal beekeeping practice. *Colony manipulation* covers specific swarm-control operations; in general these aim either (*a*) to separate the 'swarm bees' from the others, or (*b*) to prevent the rearing or emergence of new queens, or (*c*) to make the old queen ineffective—by removing or caging her, or by preventing her leaving the hive.

Some of the methods of swarm control in use are noteworthy less for the effect they have on bees than for their psychological benefit to the beekeeper. Where bees are being kept as a spare time relaxation such methods are not necessarily without their merit, although they hardly belong to an objective discussion of swarm control.

Before the methods themselves are discussed, it must be stressed that swarming is not a universal hazard of beekeeping. In many parts of the world its incidence is so low that swarm control is not an important facet of beekeeping. In continental north America, for instance, a panel of beekeeping experts put a 'low swarming tendency' as low as seventh out of eight requirements of a good strain of bee; it was less important to them than for instance getting white honey cappings, or moderation in the use of propolis[2]. In England, on the other hand, an average of 40% of colonies in amateurs' apiaries seem to swarm in spite of the application of various methods of management designed to prevent it, and in commercial apiaries 10–40%[3]. In Scotland the average proportion of colonies that swarm has been estimated at 27%[4].

In general, swarming is a material problem in the beekeeping regions where the flows are rather uncertain, where flow and dearth alternate on unpredictable dates. It is less so where the vegetation, and a favourable and reliable climate, allow a long succession of predictable flows. Under these conditions workers graduate early from hive duties to foraging: the number of house bees is kept down. One might therefore argue that the amount of queen substance[10] produced in the colony is more likely to keep the bees from building queen cells than in a colony whose forage becomes so restricted as to retard graduation from house duties.

Apiary management

Hive size and shape

One fact has recently been clearly established—swarming is induced not by lack of cells for the queen to lay in, but by lack of space for the adult bees[5]. It is thus not only the size of the brood nest that matters, but also the early addition of honey supers. A strong colony is likely to need at least 100–150 litres (space equivalent to 3 or 4 'National' brood chambers) in a cool-temperature climate; in hot regions it would need much more[6]. On the other hand, experiments in which colonies were deliberately overcrowded did not always make them swarm[7]. There is some evidence that bees in tall hives swarm more than those in long low hives[8].

Strain of bee

We now know a lot more about the swarming characteristics of strains available for breeding than we did ten years ago[9]. It is clear enough that some strains or races swarm less than others in similar circumstances, but we are still not in a position to apply to beekeeping practice much of the information available, because we do not yet know the *mechanism* of an inheritable non-swarming disposition. Is this determined by the queens' production of queen substance, by the efficiency of its distribution through the colony, or by the amount of queen substance required per bee to prevent swarm preparations, or by other factors also[10]?

Strain also partly determines colony size—itself a material factor in relation to swarming[11].

Seasonal beekeeping practice

The relative importance of different factors in inducing or hindering swarming varies according to the beekeeping environment. In one large Mexican establishment the swarming problem was solved by replacing half the combs with new foundation annually: this reduced the proportion of colonies making swarm preparations from 23% to 1%[12]. In a South African apiary swarming was reduced to 2–3% by adding to the brood nest an empty frame (without foundation) every two weeks[13].

Prevention of overheating of hives by providing shade, ventilation and ample hive space, is a wise measure[14]; provision of water can also help to reduce temperature fluctuations[15].

The practice of annual requeening certainly reduces swarming. In otherwise similar circumstances in England the proportion of colonies making swarm preparations with queens 2 years old was at least three times as high as in those with queens 1 year old[16]. It is worth noting that annual requeening is commonly practised in the good honey regions of the world, whereas in the poorer areas (with less commercial beekeeping) beekeepers tend to keep their queens for several years; it is, however, certainly not the only factor affecting swarming habits.

Colony manipulation

Before carrying out manipulations aimed at swarm control, it is necessary to know *when* to do so. And since the timing of swarm-control measures is rather critical and often varies from year to year, any means of prognosis may be helpful.

Phenological data tend to be of general rather than specific use; in Scotland the presence of active queen cells was found to coincide rather closely with the flowering period of garden lupins[17].

In German-speaking countries use is often made of a 'building frame'. This is an empty frame which can be fitted with a 'starter' on which bees can build free comb. It is placed next to the rear glass wall of back-opening hives, which is well insulated. Observations on the use the bees make of the frame can be helpful in predicting swarming[18]. The method is possible, although not so convenient, with top-opening hives, and might well be used by those keeping bees for study and interest—for instance in schools.

Use has also been made of changes in the *sounds* made in the colony in certain circumstances, notably queenlessness and preparations for swarming[19]. An apparatus for registering and interpreting the sounds (Apidictor) is now being marketed, and we should have a good idea of its effectiveness in general beekeeping practice by the end of this season.

Whether the need for swarm-control manipulations is established without opening the hive, or by direct inspection, the treatments available are similar.

Separation of bees

An 'instant' separation of the 'swarm' bees can be obtained by shaking all bees of a colony preparing to swarm on to a 'Taranov board'; the 'swarm bees' cluster underneath it and the others fly back into the hive[20]. If new colonies are wanted, removal of frames of young bees and

emerging brood to form nuclei[21] is a long-established and convenient method of swarm control. An elaboration of Snelgrove's method filters off (young) bees from the upper chamber down a tube so that they reach daylight near the normal hive entrance and re-enter to the lower chamber[22]. The Aalst method (named after the Dutch town) combines separation of bees with cutting out queen cells[23]. Most of these 'separation' methods have the advantage that new queens can be reared—under some measure of control by the beekeeper—in normal colonies, without a separate queen-rearing apiary[24].

Operations on the old queen

It has already been shown that removal of the old queen followed by requeening is effective[25]. Caging the queen for a spell is practised in some European countries (*blocage de la ponte* in French). Physical prevention of the queen's leaving the hive by a queen-excluder cover to the entrance hardly satisfies requirements of modern beekeeping.

Operations on the young queens

Removing queen cells is still one of the most common commercial methods used for swarm control, but its effectiveness has been strongly questioned[26]. Recent research has thrown light not so much on the effect of removing queen cells[27] as on the factors that initiate 'swarm' queen rearing in the first place. A whole new field of study has been opened up by the realization of the part played by secretions from the queen, which act as pheromones and determine many aspects of the social behaviour of the bees in the colony[28].

Early hopes that swarming and supersedure could be controlled by feeding the colony with regulated amounts of queen substance from the queen's mandibular glands (or alternatively synthetic 9-oxodecenoic acid) have not so far been realized. It has, however, been shown that one or other of the secretions from the queen's mandibular glands—or alternatively the synthetic material—can give complete control over the swarm itself[29]: it is one of these substances, probably 9-hydroxydecenoic acid, which attracts the bees to the queen and keeps them clustered round her.

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