

## SELECTION AND HYBRIDIZATION, FUNDAMENTAL REQUIREMENTS IN BEEKEEPING\*)

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Bee selection work has not kept pace with the successful results obtained in the other animal breeding branches up to now, because of the bee reproduction which is a complex process, difficult to control. The great obstacles faced in controlled reproduction caused either use of improper methods, or *simply giving up any attempt to influence the genetic basis*, with the local bee — living for thousands of years in hollow trees or skeps — being accepted with all its advantages and disadvantages.

In most zones where beekeeping is practised nothing has changed in this respect. Oddly enough, many beekeepers still believe that good production results can be obtained without any selection of the strains reared.

In the last decades however, both the knowledge about the honey producing performances and the technical facilities have developed to such an extent that at present several selection methods are available — although their application requires considerable effort :

### 1. *Mass selection by using selected breeder queens*

This method is based on the fact that from the daughters of the selected mothers drones with the gene pool of the selected mothers are obtained — irrespective of how had the daughters mated. And this means that a relatively large, compact population of selected drones can be obtained from naturally mated queens.

For this mass selection, a great number (several hundreds) of bee colonies with queens whose mother is of known origin are necessary.

### 2. *Breeding lines or hybrids — by natural mating*

For this, completely isolated mating places are required (5—10 km distant from any apiary), where selected queens and drones are located.

### 3. *Breeding by instrumental insemination*

This is the most convenient and opportunity-providing method as different mating combinations can be made by instrumental insemination. The technical procedure is so perfected at present that it may

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be used on a large scale, as routine work. (See *The Instrumental Insemination of the Queen Bee*, APIMONDIA Publishing House, 1975).

*Objective assessment and selection of the breeding colonies* is now made by a method devised by international co-operation; it has been used for several years with very good results (Symposium on Controlled Mating and Selection, Lunz am See, 1972, APIMONDIA Publishing House).

Many examples can be given of the *positive results* obtained by these modern methods. It is desirable that they are more frequently used, instead of the apparently more convenient but actually very questionable practice of *importation of foreign bees*.

Unfortunately, in most cases the requirements of a modern breeding programme (*breeding and mating stations*) are not met.

Any breeding work begins with the *selection of the economically most efficient animals* in the production branch concerned. In honey bees this means that one will select the colonies adapted to the local climatic and flow conditions, whose swarming impulse is low and honey yields high with the modern management methods. On the basis of the experience gained for several decades, standard requirements for an efficient selection have been decided upon — due account being also taken of secondary characteristics such as behaviour, propolization, etc. Selection must be made under the same conditions as with management for honey production, and must be underlied by the principle that only colonies tested under the same conditions and in the same place can be compared. The test results recorded in one zone cannot be expected to be recorded in another region. This fact, proven by experience is often neglected today: a great number of queens are introduced into zones with primitive beekeeping. One of these negative examples is the importation of tens of thousands of queens of European origin into some countries in the Near East, with no attempt at all having been made for testing the economic efficiency of the local bee, already adapted to the local conditions. In most cases up to now the results of such importations were negative.

Another example, but with opposite results, is the importation of *African bees* into the tropical zones in South America where they appeared to be definitely superior to the European races, their management being quite a problem.

Selection is not only the first step in breeding work, but a *permanent requirement*. Breeding work will depend in the future on the extent to which the negative effects of inbreeding will be avoided. Selection means use for reproduction only of the individuals meeting the requirements of the selection purpose concerned (productivity, swarming impulse, etc.). Whether of 100 bee colonies 10 are selected for re-

production, no descendants will be obtained from the other 90. All individuals of the next generations will be more or less closely related, meaning a higher or lower inbreeding coefficient.

In bees, *inbreeding* would very entail a reduction in vigour (inbreeding depression) and all progress achieved in selection might be wasted, or have on opposite effect. On the other hand, in many hybrids (but by far not in all!) a considerable heterosis effect is recorded to exist, resulting in greater vigour and higher crops.

With a thoroughly prepared and precise programme and with selection for vigour and brood rearing activity the inbreeding coefficient can be restricted for a long time to such a low level as to be considerably exceeded by the selection progress.

In this context, an optimum breeding programme requires :

1. Objective selection in *test apiaries*
2. Maintenance, by rigorous selection for several generations, of a rate of *inbreeding* which should result in genetically stable lines
3. *Crossing* of these lines for obtaining economically efficient and vigorous colonies. The latter are used as breeders for mass production of two-way hybrids, by natural mating.

Specific differences exist in terms of crosses, which are important for the final results and subsequent effects :

1. Crosses of selected lines obtained from the same population — *line hybrids*.
2. Crosses of different lines of different populations of the same race — *strain hybrids*
3. Crosses of lines of various races — *race hybrids*

Obtaining hybrids — notably the basic lines — requires in principle the same operations (selection — inbreeding — crossing), with only the degree of relationship of the lines crossed being different. The type of crossing is chosen depending on the conditions concerned.

He who wants to obtain race hybrids, in countries with a native bee race, must thoroughly consider the ample scope of the consequences of such an undertaking. The local bees might be replaced, possibly for good and all, by the imported bees, and uncontrolled hybrids, often with undesired characteristics, will occur. For such a breeding programme preserve zones are absolutely necessary, for preserving the purity of the native bee stock — the partner for crosses.

For successful achievements in the more distant future, in any breeding programme expertise and much patience, as well as thorough knowledge of the biological processes are required. Truly successful selection means obtaining a constant increase in the average honey crops — usually at a low rate only, not spectacular but short-lived performances.