The Africanized bees in Brazil and other countries in South America vary enormously in behaviour and appearance, and, most importantly, in aggressiveness under different climatic conditions. Researchers in Brazil have been able to prove that the aggressive behaviour of Africanized bee populations, tested in two different climatic conditions in Brazil, was more influenced by external factors such as climate than by the bee's genotypic composition. The research also confirms that the genes for aggressive behaviour do not function alone, but interact with environmental factors to produce the final behavioural phenotype, the response.

The Africanized bees have changed beekeeping in Brazil. Just after their introduction in this country many beekeepers, especially those from Rio Grande do Sul, went out of business because they did not adopt the new methods necessary to manage Africanized bees, but currently the beekeeping industry is better organized and honey production is increasing each year. Although some beekeepers still claim that it is difficult to handle the Africanized bees and prefer to work with European bees, most are adapting themselves to the hybrids, and the Africanized bee is no longer considered undesirable by the majority. In São Paulo, Paraná and Santa Catarina many beekeepers prefer to work only with Africanized bees because of their high productivity. According to Mr H.Wiese, President of the Brazilian Beekeeping Confederation, national honey production increased from 4,000 tons in 1972 to 15,000 tons in 1980, proving that Brazilian beekeepers have developed a good management scheme for Africanized bees. The good climatic conditions and good flora of Brazil, combined with the good productivity of the bee, have vastly improved Brazil's position in the international honey market. LSG

See also TROPICS, HONEY BEES IN.

Brazilian pepper, also known as Mexican pepper, Christmas berry and, on the French Mediterranean coast, faux poivrier, has the scientific name *Schinus terebinthifolius*. A native of Brazil, it has been introduced into Europe, North and South Africa, Asia, and many US states, including Hawaii. The plant cannot survive frost and grows only in the tropics and subtropics. Though the honey it produces is yellow and contains much pollen, the pepper is described almost everywhere as an excellent honey plant. In Bermuda, for example, beekeepers expect the island's 400 colonies to double to 800 because of the good nectar flows.

The nectar flow occurs in the fall, when the daylength is decreasing in the northern hemisphere and when there is a dearth of other nectar. Most of the honey is sold to the bakery trade, or used for building colonies in preparation for honey flows with a higher quality honey.

The balsamic resin from the tree contains toxic substances that can cause skin inflammation. The plant's bright red berries are also said to be toxic, and to cause upset stomachs in children and other animals that may eat the berries.

The Brazilian pepper tree is one of many excellent plants which have been accidentally or purposefully spread around the world, and are often regarded as noxious weeds. Others in this category are dandelions, yellow rocket, purple loosestrife, and many *Eucalyptus* from Australia. In the case of the pepper, some environmentalists have become concerned as the shrub has replaced native vegetation, and in Florida there have been mild attempts at eradication.

Breeding honey bees The purpose of bee breeding is to obtain characteristics that a beekeeper wants in his bees. Each characteristic may be a generally desirable quality, such as disease resistance and infrequent stinging, or one with a specialized quality, such as cordovan body colour, a tendency to pollinate alfalfa, or the ability to survive a winter in central Finland. Because of differences in climate, flora and management practices, a bee that is very good in one geographical area may not be good in another. Thus, breeding is most effective when it is done in the area where the bee is to be used.

Bee breeding begins with specific objectives and a clear plan to achieve the objectives, whether these be the acquisition of single, simple characteristics or multiple, complex ones. The following questions must be considered by the bee breeder: what characteristics are wanted, how can these characteristics be measured, will these characteristics respond to selection, and can these characteristics exist together in a single bee? Ideally, a breeder would know the answer to these questions, but in reality there is much guesswork needed. When specific, measurable characteristics are chosen, selection can begin.

Selection begins with many colonies of bees which are collectively called a breeding population. A more diverse population will contain more characteristics from which to select. Fortunately, honey bee populations throughout the world and even in specific localities have not been made extremely uniform by man, so a variable population is usually easy to find.

Line breeding is by far the most widely used system. Selection in line breeding involves evaluating each of

the colonies in the breeding population for the particular set of characteristics that were decided upon. Each colony can be given a numerical value for each characteristic, and the colonies with the highest combined scores serve as breeders. This process is repeated every year.

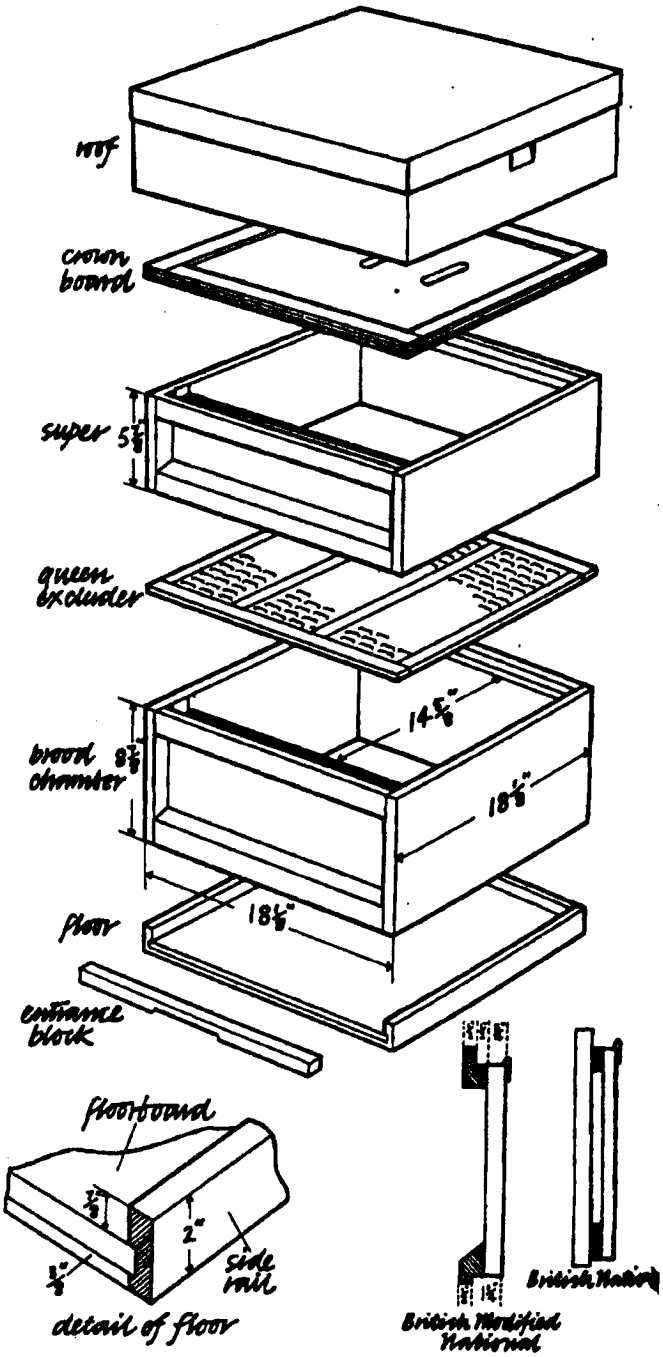
Line breeding, even at a very simple level, has been effective in improving stock. In the 1930s, Dr Haydak at the University of Minnesota improved honey production in a group of only 22 colonies from 148 to 398 pounds per colony by using simple line breeding, without controlling mating. Two important features of this project were culling the queens from the poor producing colonies and producing queens from the best.

Unfortunately, line breeding leads to inbreeding. Since the rate of inbreeding is reduced as the number of breeder colonies is increased, about 15 per cent of the colonies should be used to produce queens and drones for the next generation. When inbreeding becomes a problem (evidenced by a scattered brood pattern) unrelated stock must be added to the breeding population.

Hybrid breeding differs from line breeding in that at least two lines need to be developed, and these lines are intentionally inbred. Selection techniques can be similar to those used in line breeding or they can be much more complex, by planning for specific characteristics such as disease resistance in one line to complement the disease-resistant characteristics in another. These two-or-more inbred lines are then mated to one another to produce the final product.

Hybrid breeding has both advantages and disadvantages when compared with line breeding. The advantages are that selection stops, or at least slows, once the inbred lines are developed, that inbreeding need not be avoided, that hybrid queens are more uniform than linebred queens, and that the same hybrids can be produced year after year, as long as the inbred stocks are kept. The disadvantages are that hybrid breeding requires the specialized skill of INSTRUMENTAL INSEMINATION to assure precisely controlled matings, and that inbred lines require special year-round care to ensure their survival. Instrumental insemination, of course, removes the random or variable factor involved in breeding programmes which rely on mating on the wing, with drones from uncontrolled sources. It is commonly said that supersedure queens from a hybrid are poor. This is not true. A supersedure queen from a hybrid is usually good, but the quality of her brood depends on the unknown drones with which she mates. This uncertainty is common to all supersedure queens. For example, inbreeding would arise if a supersedure queen mates with drones produced by a sister queen or a similar hybrid queen. JRH

See also GENETIC PROBLEMS OF INBREEDING; GENETICS OF THE HONEY BEE; QUEEN REARING.



The British Modified National. The queen excluder is shown as for a top beeway hive. For the normal bottom beeway hive it would be reversed. The detail on the LEFT *shows the method of construction of the floor, and the cross-sections of the chamber wall show the difference in construction between the Modified National* LEFT *and the original* RIGHT.