

Stock Center Inventory — 1973¹

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IN the June 1972 issue of this Journal, W. C. Roberts introduced the Honey Bee Stock Center to the apicultural world, described what we were doing, and explained our policies of accepting and distributing stock.

Purpose

The purpose of any stock center is to maintain and distribute genetically defined lines of animals or plants. Many such centers exist in the United States and elsewhere. The centers maintain and distribute lines of rats, mice, *Drosophila*, seed corn, or algae, to name just a few. When a unique or exceptional line is developed, it may be placed in a stock center for safe keeping. Similarly, when an exceptional honey bee line is developed, it may be sent to the Honey Bee Stock Center for maintenance and distribution.

The long range goals for the Honey Bee Stock Center are twofold: (1) to produce and maintain genetically defined bees for bee research and (2) to develop superior stock that will benefit American agriculture. This first point is important because almost all bee research is presently being conducted with genetically undefined stock.

To achieve both these goals, the Stock Center has an active research program. The research is designed to improve the technology of stock maintenance and to further our understanding of honey bee genetics and inheritance. At present, our efforts are directed toward improving sperm storage techniques, developing improved methods for storing queens and drones, screening for possible carbaryl resistance, expanding our knowledge of sex determination, and producing a karyotype (photographic identification of honey bee chromosomes). Much time will also be used to characterize the lines of bees that are maintained that

is, in the evaluation of such characteristics as longevity, vigor, temper, and production.

Inventory of Stock

The Stock Center presently maintains 18 inbred lines of honey bees. These lines, and known historic and genetic descriptions, are listed here. However, the descriptions are for the most part casual observations and opinions, not scientific conclusions. Equally important, the lines were evaluated in the climatic region of Baton Rouge, Louisiana. Except for NZ, HAPC, and all the lines maintained Baton Rouge were started by Dr. William C. Roberts, and many of the descriptive characteristics are his observations.

You will note that we have tried to avoid excessive use of subspecific names such as Carniolan, Caucasian, and Italian. Pure lines probably do not exist (at least not in the U.S.). For lack of more descriptive terminology, we refer to black lines and yellow lines, and the list of inbreds is arranged with the most black first and the most yellow last.

Ka — Very dark bees with no yellow bands. The queens are completely black, above average in size, and prolific egg layers. They start brood rearing relatively late in the season (late January). Brood production, build-up, and honey production are above average, but Ka propolizes more than most lines. Ka produces a good colony when mated to YR drones, but naturally mated KaYR daughter queens have produced bees possessing some temper.

The Ka line was begun in 1963 from Carniolan stock that was imported in a particularly interesting way. The eggs were shipped from England to Guelph, Ontario. Dr. Maurice V. Smith of Guelph produced the queens and shipped the virgins to Dr. William C. Roberts in Baton Rouge. Dr. Friedrich Ruttner shipped the semen from Germany to Baton Rouge in a capillary tube, and Roberts used this semen to inseminate the virgins from Canada. In short, the queens began their life in England, were reared to adult in Canada, and were mated in Baton Rouge to drones that had lived in Germany.

RR — Very dark bees with no yellow bands. The queens have some yellow-coloration on segments 2-6 and are somewhat smaller than Ka. They seem to be average layers.

RR is a moderately inbred line that was started in 1967 with the importation of Romanian semen from Dr. F. Ruttner in Germany.

We — Very dark bees with no yellow bands. The line resembles the description of German bees in the U.S.



An inventory of the personnel at the Honey Bee Stock Center, left to right: William Gordon, Eugene Jensen, Kenneth Tucker, Gary Reynolds, Jack Bishop, Mary Sutherland, Elizabeth Warrick, and John Harbo.

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before 1850. The queens are small, nervous, very runny, and average to above average egg layers. Like the queens, the workers are very nervous and runny, and We colonies often sound queenless even though queen-right. They seem to be inclined to jam the brood area with honey, which may decrease the amount of brood and subsequently the population. Although these bees are good honey producers, their overall honey production is below average — probably because of small populations. A fair amount of variability remains in this line, and frequently the We colonies have undesirable temperament.

The We line was begun in 1967 from stock received from Clarence Wenner in Glenn, California.

Kb — Much like Ka except that the queens are below average egg layers; thus the colonies are below average in brood production. Kb workers seem to be as black as Ka workers, but Kb queens have some yellow coloration on segments 2-6.

The Kb line was started in 1967 with a Carniolan import. It is related to the Ka line.

An — The An line has very dark bees with no yellow banding. The queens are fairly large and are good layers. Throughout the season, brood production is usually good enough to maintain above average populations. Although the An line has been inbred for nearly 10 years, it still exhibits variability in temperament. Hybrids produced by crossing An queens with Pa drones show some promise.

The An line is moderately inbred. It was begun in 1963 from an Anatolian race selection.

HB — A dark line but lighter than Ka, We, or An. The queens are small and poor layers. The eggs seem smaller and less robust than eggs from most other lines. Workers are nervous (but with acceptable temper), small, and have a slight greyish cast. HB may be more susceptible to EFB than most of our other lines.

HB is a moderately inbred line originating from English and Caucasian stock. The line was created in 1961 or 1962 by combining the H and B lines. Since the 1961-62 records are missing, we do not know exactly how these lines were combined.

The H line was begun in 1956 from a Caucasian queen received from the Bolling Bee Co. in Greenville, Alabama. The B line began in

1947 with stock received from C. G. Butler in Rothamstad, England. In 1952 a mixture of Y, Short, Caucasian, and wild stock was added to B, which reduced it to 85% Butler stock. In 1955, D (see YD) was added to B to make it about 12% D.

Tc — Bees quite dark, but variable. Queens are average in size, nervous, and prolific layers. Brood production is good; starts in late January and ends in mid November. Above average to good populations are maintained. The workers are nervous, runny (slightly less than We), above average honey producers, and often hot tempered.

Tc is a line that was begun in 1969 from Russian Caucasian stock which had been naturally mated (probably to yellow Italian drones) for 1 or 2 generations.

De — A dark line started in 1971 with semen received from Brother Adam in England. Uncharacterized.

Gk — Intermediate between black and yellow, but variable. The workers are small and have 1 or 2 yellow bands. Queens are below average egg layers, populations do not build up well, honey production is below average, and wintering ability is poor. However, good hybrids are produced when Gk is crossed with YD.

This line was begun in 1963 with Greek imports and Dymant drones. It is a moderately inbred line. In 1966, an additional Greek import was added to the line to make it about 75% Gk and 25% Dymant.

CAR — Intermediate in color. This line was selected for resistance of newly emerged queens and drones to topical application of the insecticide carbaryl. The bees are nervous and runny, while the queens are relatively calm.

Dr. Kenneth W. Tucker began selecting for carbaryl resistance in 1968. From a preliminary screening of 99 colonies, 4 queens were selected: a GKYO x wild, a yellow California queen x YD.GK.YR, and 2 wild queens. From these four queens Dr. Tucker continued selecting for carbaryl resistance for 9 generations. In 1973 his inbred line was deposited in the Stock Center, where in a selection pressure for carbaryl resistance will be maintained.

RW — The line was begun in 1971 with stock received from Roy Weaver in Navasota, Texas. Uncharacterized.

HAPC — A line selected for the tendency to collect alfalfa pollen. Al-

though no alfalfa is grown in southern Louisiana, the bees do seem to store large quantities of pollen. This line has large, yellow queens that are good egg layers. Brood rearing begins in early January, and build up is excellent, with above average to good populations found in most colonies.

Less than 50% inbred. The line comes from wild stock in Utah. Dr. Otto Mackensen and Mr. William P. Nye of the Baton Rouge, and Logan ARS laboratories respectively, did the selection for alfalfa pollen collecting during the 1960's, and in 1970 the Stock Center received three HAPC queens from Dr. Mackensen. Since we received the stock, we have not selected for pollen collecting, and have maintained HAPC as another inbred line.

Mb — A yellow line of bees that usually has 4 or 5 yellow bands. The queens are leathery colored, large, and below average egg layers. Their rate of supersedure seems to be quite high. Honey production is good, but the bees exhibit some temper.

The Mb line was started in 1969 from Italian stock received from Otis Mitchell in Bunkie, La. The line contains about 15% Homer Park stock.

Pa — A yellow line having 4 or 5 yellow bands. The large queens in this line are the best egg layers in any of our lines. Brood rearing begins in early January and continues through late November or early December; good populations are maintained throughout the season. The bees store very little honey and appear to be especially susceptible to AFB. Pa makes a good cross with An and a good 3-way hybrid with YD.Gk.

Pa is a moderately inbred line started in 1968 with Italian stock received from Homer Park in Palo Cedro, California.

Pb — Similar to the Pa line except that the queens are somewhat less prolific. Brood production is above average.

Pb is a moderately inbred line started in 1968 with an Italian queen received from Homer Park, Palo Cedro, California. The Pb line contains about 25% Pa.

NZ — Another line that we received from the Madison Laboratory in 1972. It comes from New Zealand and is uncharacterized.

LM — One of our most yellow lines. The queens are large and prolific.

Brood cappings are concave, and the eggs seem small. The bees are very gentle and seem to be highly susceptible to EFB. Hybrids produced by crosses of Mb queens with LM drones show some promise.

LM is a highly inbred line. It was created in 1959 by mating M drones to L queens. The L line was started in 1952 with a queen received from H. C. Short. The M line was begun in 1946, and is still maintained in Madison (see M line).

YD — A very yellow line. Queens have good (stubby) size but are poor layers. They winter poorly, use lots of honey, and store very little. YD begins rearing brood early in the season and ends late. When crossed with Gk, they produce good hybrids.

YD is a highly inbred line. This line and YR originated in 1938 when W. C. Roberts was studying color inheritance in bees. He tried to create a line that was as yellow as possible. YD was created in 1960 by combining the Y and D lines.

The Y line was begun in 1938 with yellow queens received from Mike Stevenson (a New Orleans queen breeder). In 1945 the line was crossed with a Burleson-Short hybrid. It was again outcrossed in 1947 this time to a Harrel queen. Mathematical analyses in 1950 indicated that the Y line probably contained 33% Harrel, 47% Stevenson, 10% Short, and 10% Burleson. The D line was started from a Short queen in 1946.

YR — Related to the YD line, and like YD, it has been selected for yellow coloration. The queens appear vigorous but are poor layers. Good hybrids are produced by crossing with Ka. YR is a highly inbred line created about 1961 or 62 by uniting the Y and the R lines.

For the history of the Y line, see YD. In 1952, W. C. Roberts split the Y line into Y and R. Stock from Moore and Short was added to the R line, which left R about $\frac{2}{3}$ Y.

The following eight lines are maintained at the Bee Management Research Laboratory in Madison, Wisconsin.

B — A very dark black line. The queens are large and good layers. B will uncapped AFB brood. When combined with the Z line, B produces a very productive hybrid.

The B line was started in 1955 with a Caucasian queen received from Mr. Gafford of the Bolling Bee Company in Alabama. It is a highly inbred line.

H — A very black line. The bees are very gentle and could almost be called "timid." They propolize excessively.

The H line was begun in 1964 with Hastings Caucasian stock obtained from John Holzberlein in Colorado. It is only slightly inbred because before 1969, it was annually bred from a four-queen population.

Z — Also a black line. Z queens, however, are not as dark as B or H. The queens are big and produce a large number of eggs. Although they are not vicious, they do exhibit some temper.

Z is a highly inbred line that was begun in 1952 with Caucasian stock from N. R. Chamberlin in Poplar, Wisconsin. In 1958, the X line was mixed into Z, making the Z line about 10% X.

X — A black line. X queens are big, but are not prolific layers. They possess some temper and in certain hybrid combinations are extremely vicious. Excellent hybrids are produced by crossing with BZ queens. Daughters of these BZ x X queens are the "Island Hybrids" that have been used by beekeepers for many years.

X is a highly inbred line started in 1952 with stock from Baton Rouge. The Baton Rouge stock had come from C. G. Butler in England. The line contains about 15% Z.

A — A dark cordovan line. The bees are runny but are not exceptional in any respect. This line seems to combine well with other lines to produce good hybrid stock.

A is a moderately inbred line that was begun in 1954 as a general selection from Gafford, Short, and others. Its ancestry is primarily Caucasian.

M — A very light cordovan. They will uncapped AFB brood.

M is a highly inbred line that was begun in 1946 by selecting light colored offspring from a Caucasian — Moore naturally mated queen. It is related to the LM line which is maintained in Baton Rouge.

D — A yellow line. This line is a good brood producer and a non-propolizer.

The D line was started in 1957 from stock received from the Dymont brothers in Canada. It is moderately inbred.

NZ — Yellow stock from New Zealand. This line was begun in 1972 and is also maintained in Baton Rouge. Uncharacterized.

Maintaining inbred lines

The inbred lines are usually maintained by making aunt — niece crosses (Polhemus *et al.* 1950) at the rate of one generation per year. Consequently, the longer we maintain these lines, the more inbred they become.

With inbred bees, more than just the usual loss of vigor occurs. Like inbreds of many other plants and animals, inbred bees continue to lose vigor as the degree of inbreeding increases. However, the poor brood pattern found in colonies headed by inbred queens is probably more striking than this loss of vigor.

The relationship between inbreeding and brood pattern of honey bees (commonly called brood viability) is unique. In an inbred colony, the queen will lay eggs in a compact pattern, but shortly after hatching, many of the young larvae are removed by the workers. As the degree of inbreeding increases, the proportion of removed larvae increases until the limit (50% removal) is reached. This phenomenon of removing larvae has been linked to the mechanism of sex determination in honey bees (Mackensen 1951, Woyke 1963).

Because of the overall loss of vigor and the spotty brood pattern, colonies headed by inbred queens are usually poor. As a result, colonies of some of the more highly inbred lines (especially YD, YR, LM, HB, and Gk) require special attention: They do not build up well, and in the winter they dwindle rapidly. To remedy this problem, one must periodically add honey and non-inbred bees to these colonies or routinely transfer the queens to non-inbred colonies.

Why Maintain inbreds?

Some inbred lines are maintained to conserve specific heritable characteristics. Others were chosen for maintenance because of such items as unique origin, temperament, productivity, or color. By studying these lines and specific crosses between these lines, we can evaluate how particular characteristics of bees are passed from generation to generation.

In addition to their value to genetic research, inbreds are the building blocks for producing hybrids. When two or more inbred lines are crossed, their progeny are called hybrids. These crosses may be between two or more lines of similar color or between different colored lines. Color is not the

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