

QUEENS, PACKAGE BEES, AND NUCLEI: PRODUCTION AND DEMAND

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The production of queen bees, package bees, and nuclei provides for the establishment of new colonies, the replacement of dead colonies, or the rejuvenation of ongoing colonies. It renders these objectives as planned management, instead of the haphazard and often ill-timed replacement of colonies by swarming and of queens by swarming or supersedure.

Most queens, packages, and nuclei are produced by beekeepers who concentrate on this specialty of beekeeping. Most beekeepers who manage bees for the production of honey and wax or for pollination leave the propagation of queens and bees to a specialist for several reasons. Probably the most important reason is that the specialist in queens and bees can produce them at less expense than could other beekeepers. The specialist also requires considerable experience in many detailed rearing techniques, in comparing breeder queens to ideal standards of performance, and in testing for uniform performance of the daughter queens. The specialty also requires considerable investment in equipment used just for queen and bee production.

The annual dollar value of queen and bee production for 1975 was probably about \$10 million to \$15 million. California, where county-by-county production statistics are available, accounted for about half this production. For Texas and the Southeastern States, the estimate was based on the guess that about half the queens and a third of the package bees were produced there. This estimate indicated a production of about 1 million queens and 500 tons of package bees but did not include a complete accounting for queens, bees, and nucs (nuclei, small colonies) used within the same beekeeping operation. Partial figures for large migratory bee operations indicated a production of perhaps 100,000 valued at about \$2 million.

As an industry within an industry, the queen and bee business operational expenses and earnings become the operational expenses of other beekeepers. Some large honey producers and pollination contractors have integrated queen and bee rearing into a "vertically" enlarged beekeeping operation. Typically, such operations locate in mild winter areas for queen and bee production during winter and spring, then locate in cold winter areas for honey production or pollination in summer.

Queens

Queens usually are sold as young mated adult queens that have been laying eggs for only a few days. These queens most often are reared from 12- to 24-hour-old worker larvae, transferred ("grafted") from worker comb into specially prepared queen cell cups. The developing queens are reared in either queenless colonies or next to young brood in part of a queenright colony from which the queen is excluded. Completed queen cells, when within a day of the queen's emergence as an adult, are placed individually into small, queenless colonies of bees, called mating nucs. About 2 weeks later, the young queens will have mated and be laying. For shipment, each queen is placed into a mailing cage supplied with candy along with 7 to 10 young worker bees from the mating nuc (fig. 1).

Package Bees

Package bees usually are sold caged in 2- or 3-pound units, along with a caged laying queen and a pint can of sugar syrup. Bees for packaging usually are shaken from the brood combs of the upper part of strong colonies, so that mostly young adult bees will be included. The bees are shaken through a funnel into the packages or into a "shaker box" until about 10 pounds of bees have accumulated; then several packages are filled from the shaker box. Cages for shipping packages are made of wood and screen, in a way that com-

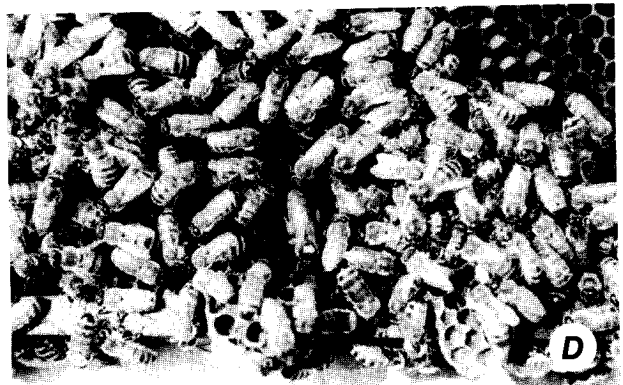
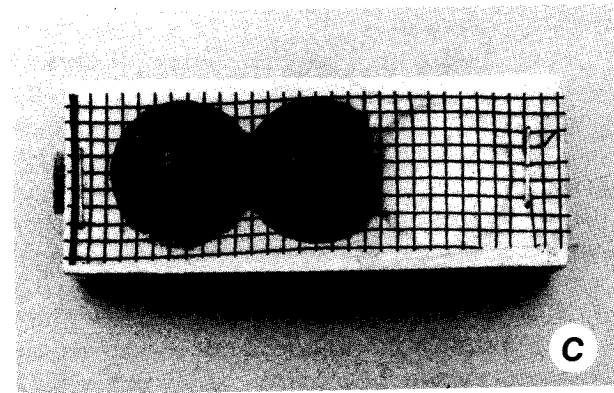
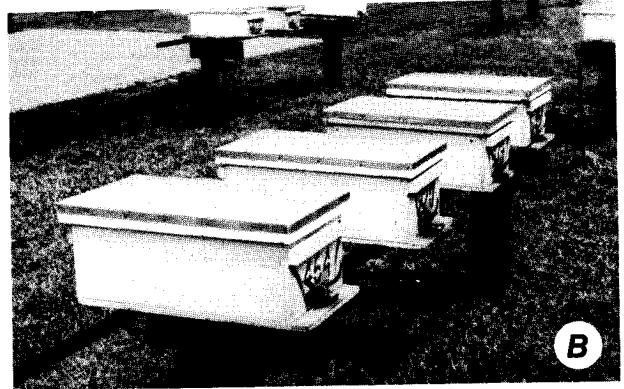
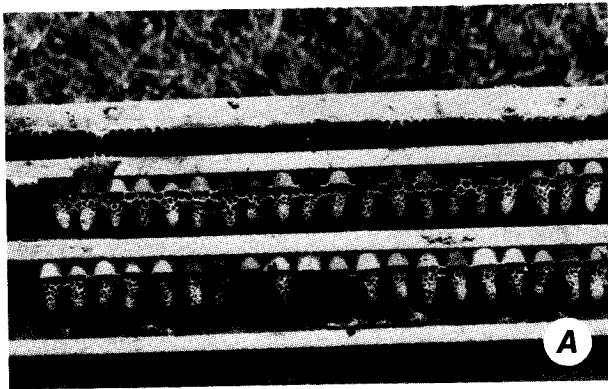
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bines lightweight, sturdiness, and a maximum of screened area through which the bees can ventilate their cluster (fig. 2).

Nucs

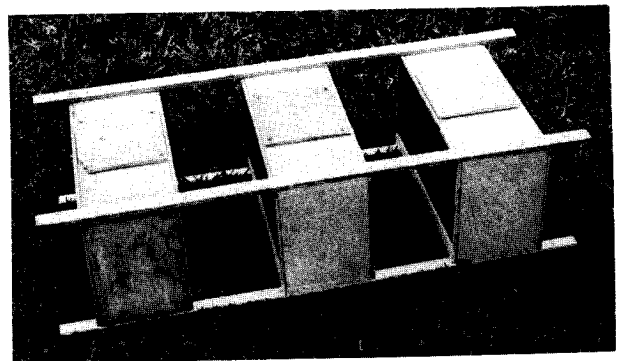
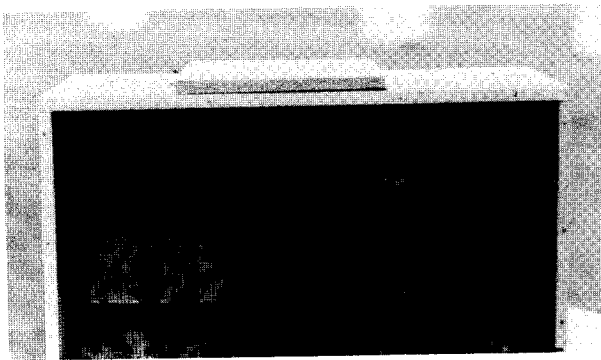
Nucs or nuclei are small colonies with queens. They usually are composed of three to five combs of bees and brood with a laying queen. These may

have been the mating nucs for the resident queens, or queens mated elsewhere could be introduced into nucs newly assembled from strong colonies. Nucs intended to develop into full-strength colonies are made up in equipment of the same size as the full-strength colony, in contrast to most queen-mating nucs, which have much smaller combs (fig. 3).



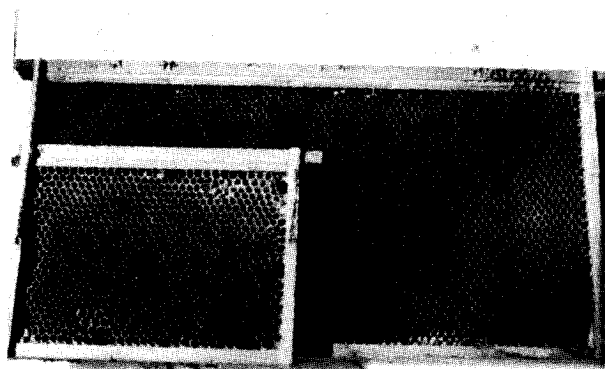
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FIGURE 1.—Queen production: *A*, Completed queen cells; *B*, mating nucs in queen mating yard; *C*, young laying queen on a nuc comb; *D*, queen and attendant worker bees in shipping cage.



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FIGURE 2.—Package bees: *Left*, Single package; *right*, packages crated for shipment.



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FIGURE 3.—Popular comb sizes for nucs. Smaller size is mating (“baby”), size $6\frac{1}{4} \times 8\frac{1}{2}$ inches; larger, standard Langstroth comb, $9\frac{1}{2} \times 17\frac{1}{2}$ inches.

Management for Queen and Bee Production

Queens are best reared and bees and brood most efficiently produced under those circumstances which accompany the spring swarming season: colonies near peak population, an abundance of nectar and pollen, and a readiness to rear drones in abundance. The season of abundance can be started earlier and extended later by feeding sugar syrup and pollen substitutes when nectar and pollen flows are inadequate. For maximum production of queens, drones, and bees, conditions of abundance should be maintained for as much as 2 to $2\frac{1}{2}$ months before the anticipated date of queen production and continued as long as queens are still to be mated. Drone production is the most sensitive to nutritional inadequacies and should be used to gage rearing conditions. By early and continued feeding, the rearing season may be advanced by a month and production of bees for stocking mating nucs and for packages increased.

Demand for Queens and Bees

The demand for bees and queens is based on the use made of them. These uses usually are the start of new colonies and the continuance of established colonies.

New colonies may be started in a variety of ways. A 2-pound package with a laying queen installed onto drawn comb and provided with adequate honey or syrup and pollen or pollen

supplement should be expected to develop into a strong colony in about 12 weeks (four brood cycles). A three- or five-frame ($9\frac{1}{8}$ -inch depth Langstroth) nuc with a queen should be expected to develop to the same strength in 9 weeks (three brood cycles) because it has brood already present. Either the package or the nuc option may be made starting with only a shipped queen, but with the bees and brood supplied from other colonies managed by the recipient of the queen. Of these two options, the nuc (also called a divide or split) probably has been used most, with the bees and brood taken from the strongest overwintered colonies. A few northern beekeepers shake their own packages.

For the continuance of established colonies, usually only a queen is needed. These queens are used to replace older queens which are no longer laying well or to change the nature of the bees of a colony that may be unproductive, overwinter poorly, sting too much, use too much propolis, or have any other characteristic the beekeeper thinks undesirable.

The demand for bees and queens also reflects the ways in which the recipients expect the bees and queens to fit their management. The recipient beekeepers must make decisions based on economics and on the seasonal cycle of weather and honey flows in their localities. These decisions include whether (1) to operate with perennial (overwintering) or annual (bees killed in late summer or fall and the hive restocked in the spring) management (which depends upon whether the beekeeper expects surplus honey from new colonies in the same season or not until the next year), (2) surplus honey flow or pollination is early, mid-season, or late, and (3) to establish new colonies or replace queens.

These management decisions by the recipients of queens and bees have dictated two aspects of the queen and bee industry: the shipping season and the geographic location of the industry.

The relation between management options and shipping season is summarized in table 1. Currently, and for the past 50 years, the shipping season for most queens and bees has been early spring, from March to May. The reason for this has been the dual demand for bees to replace winter losses and a very strong demand from annual management without overwintering. But with less annual management and more overwintering, it

TABLE 1.—Demand for queens and package bees or nucs related to bee management and to timing of honey flows or crop pollination

Management				Time of year to receive queens and bees ¹		
Type	Time of flow or pollination	Objective	Requirement	Early spring	Late spring to early summer	Late summer to early fall
Perennial	Late spring-early summer.	Replace queens	Laying queens	P	O	P
		Replace and/or increase colonies.	Packages or nucs with queens.	P	O	
Perennial	Fall	Replace queen	Laying queen	P	P	P
		Replace and/or increase colonies.	Packages or nucs with queens.	P	P	
Annual ²	Late spring-early summer.	Replace colonies	Packages or nucs with queens.	P		
Annual ²	Fall	Replace colonies	Packages or nucs with queens.	O	P	

¹ P-prepared time; O-useful optional time.

² Bees restocked each year and killed after honey flow or crop pollination.

seems possible that the shipping season may spread out from the spring concentration.

Because of the heavy demand for queens and bees in early spring, the queen and bee industry has become concentrated in the mild winter areas of the country. Thus, most queens and bees currently are produced in Georgia, Florida, Alabama, Mississippi, Louisiana, Texas, and the Sacramento Valley of California.

Shipment

The shipment of bees and queens between the producer and recipient relies on rapid transportation and careful handling en route. Queens are shipped in small wood and wire-screen cages, along with 7 to 10 attendant worker bees and some candy, via airmail as far as the other side of the world. Package bees are shipped largely in the recipients' trucks, where they receive optimal care. For package bees, air freight is feasible but expensive; railway express, once the most preferred by the industry, now has too few routes and too many handling problems; parcel post is feasible for small shipments, but handling has been variable. The shipment of nucs, as with larger colonies, is best attended to by experienced beekeepers, who know that bees need water and cannot stand much heat: therefore, they are best shipped on the recipient's truck.

Looking Back

Planned queen rearing began in the mid-19th century with the advent of the movable comb hive. Besides rearing queens from swarm or supersedure cells, queens were reared from eggs or very young larvae in bits of worker comb taken from the breeder colony and transferred to a strong queenless colony. (That queens could be reared in this way was already known by 1771, but was facilitated by the use of the movable comb hives.) Several methods of planned queen rearing were developed by the 1880's, of which the most convenient and widely used to this day is that outlined above. Controlled mating by instrumental insemination, developed between 1925 and 1945, has been used by a few queen producers for breeding and lately is beginning to be used for mass-produced queens.

The shipment of queens in small cages, with attendant worker bees and food, developed apace with queen-rearing techniques. Early shipments of queens caged with a piece of comb honey and a bit of water-soaked sponge succeeded by railroad transit for up to a few thousand miles. But distant shipments, as from the Eastern United States to New Zealand, took up to 63 days by rail and ship, and for these, adding a small piece of emerging worker brood to the cage enhanced the chance of survival of at least some queens of a

shipment. By the 1880's, a fondant-type candy was being used to replace the comb honey, in response to the express carriers who found the honey-supplied shipments messy. Since the advent of reliable airmail, shippers have sent queens to all parts of the world with excellent prospects of survival.

The reasons for the demand for queens have changed since the inception of planned queen rearing. The earliest demand reflected a desire by North American beekeepers to change their stock from the existing dark bees of Northern Europe to the yellow Italian stock. This change of stock extended over an 80-year period for the country as a whole and was essentially completed by 1940. During this time, the demand for changed stock gradually diminished but is still a motive for buying queens. Demand based on replacement of poor and failing queens has been steady over time. Beginning in the late 1930's and continuing, there has been a strong demand for queens with packages for annual management on the northern honey flows.

The use of package bees was first conceived and tried in the late 1870's but really developed during the second decade of the 20th century. The demand in earlier days was sporadic and substantial only during springs following widespread heavy winter losses of colonies in the north. Volume trade in package bees dates from 1913. From that time until the 1950's, package bees were shipped with reasonable success by railway express. With the gradual reduction in rail passenger service and with the construction of high-speed highways, however, recipients of package bees adjusted by carrying package bees north by truck.

The earliest demand for package bees was to start new colonies, including replacing those that died during winter, without the expectation of a full crop of honey the first year. But with the demonstration in Manitoba during the 1920's that reasonably large honey crops could be expected during the first year from spring-package colonies, a new type of annual management developed over the North-Central and Northwestern United States and in Canada. Package colonies established early in the northern spring build up to full strength before the summer honey flow and produce a crop of surplus honey, after which the bees are killed in late summer or fall. The demand for package bees used in annual management is still substantial, but in recent years perennial management in

the north has been competitive with annual management, leading to a lower demand for package bees.

Nuclei with queens have been offered for sale since at least the 1870's. Survival of shipments in early days by rail, barge, or ship was uncertain even when the bees were accompanied by a skilled beekeeper. Only in the last 20 years has volume shipment of nucs over large distances been feasible, when they are carried on the recipients' trucks over high-speed highways.

The location of the queen and bee industry has changed over the years since the 1860's. Pioneers of the industry were located mainly in the northeastern United States. By the 1880's, queen producers were located across the country, even in very cold winter areas. Before the advent of reliable shipment of package bees, the greatest demand for queens was during late summer and fall, so that northern-reared queens were competitive. Dating from the 1870's, a few southern queen producers sold queens in early spring, but the shift of the larger part of the queen and bee industry to mild winter areas did not start before the 1910's. By the 1930's, the bee industry was located mostly in the south and in California, where it is today.

Looking Ahead

It is intriguing to guess what lies ahead for the queen and bee industry. Any changes in rearing technology, handling, and shipping of queens and bees, or in management objectives by customers, can be expected to influence this industry.

For rearing technology, future changes should be directed toward reducing the amount of detailed manual skills, the number of colonies operated per numbers of bees and queens produced, and the amount of travel within a queen and bee operation. An innovative approach to grafting may yield a system to graft 10 to 20 cells as fast as one cell is grafted now. Instrumental insemination may yet become superior to natural mating and, if so, outyards for natural mating and mating nucs could be supplanted by many fewer nursery colonies. Driving or attracting bees into cages by using repellants or attractants may replace shaking. The advent of a protein diet superior to pollen in nutrition and attractiveness to bees could lead to "feedlot beekeeping" and the elimination of outyards for queen and bee production.

Methods of shipping bees and queens probably can be improved. A diet for bees in transit better than the currently used sugars may give better survival. Controlling the climate for queens and bees in transit may be used more extensively in the future than now, building on promising systems now in use.

Finally, future changes in management objectives of customer beekeepers may change the nature of the bee and queen industry. Probably the most important change, perhaps already underway, is the return from annual to perennial management with overwintering. Another conceivable change is the exploitation of surplus honey from very early spring flows, formerly considered "buildup" flows. Both these changes may shift the season of demand for queens and bees to summer

and fall. If this happens, volume queen and bee production may again shift northward.

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