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Two-Queen System Of Honey Bee Colony Management

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Two Queen System Of Honey Bee Colony Management

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Summary

The two-queen system of honey bee colony management is reviewed to describe its mechanics and theory. Comparative honey yields of package bee, single-, and two-queen colonies are shown for 6 years in the Madison, Wis., area. Step-by-step handling and organization of honey bee colonies are described, along with equipment needs and modifications for particular purposes or areas. This system offers labor advantages, lower cost per pound of honey produced, better quality produce, less swarm problems, and better overwintering of bees.

Introduction

The presence of one queen in a colony of bees is generally considered normal. The beekeeper, however, may frequently find mother and daughter queens laying eggs in the colony and on the same or adjoining combs. Sometimes two or even three such queens have been observed to lay eggs together harmoniously. This situation may last from 1 week to several weeks and has been known to last more than a year.

In checking queens after a major honey flow, mother-daughter combinations commonly occur in about 5 percent of the colonies. Certain strains of bees show more tendency to tolerate mother-daughter queens than others. Not infrequently during late summer requeening, a beekeeper may remove a queen from a colony and be unsuccessful in introducing a new queen because a second queen or virgin daughter is still present in the colony.

Establishing a two-queen colony is based on the harmonious existence of two queens in a colony unit. Any system that insures egg production of two queens in a colony for about 2 months before the honey flow will increase honey production considerably.

The two-queen system is an intensive management system designed to produce the largest possible honey crop per hive unit. During any period of nectar flow, the production efficiency per bee or per unit number of bees increases as the population in the colony increases to its maximum of about 60,000 bees (2).¹ Thus, in single-queen units a colony with 60,000 bees may produce more than twice as much honey as a colony with 30,000 bees.

The efficiency relationship remains high when populations are further increased through the use of a second queen. Populations in two-queen colonies commonly approach twice the population of single-queen colonies. A two-queen colony may have 25 to 30 pounds of bees at its peak. Small colonies increase in population with time, and their production efficiency over a long honey flow rises. Colonies that are large and populous throughout either long or short flows produce the greatest amount of honey because they are at their highest efficiency throughout the entire flow period.

Not only do two-queen colonies produce more honey, but they also produce it more efficiently than single-queen colonies. The honey yield reflects the colony's capacity to use the nectar supply and is affected by population, size, race or strain of bees, incidence of disease, and management. Colonies and apiaries with the same nectar supply may vary considerably in their intensity of collecting honey (7).

Most beekeepers have observed that individual colonies in an apiary often produce several times the average for the apiary. Such exceptional colonies may have received drifting bees or their individual timing for buildup may have been uncommon. Such differences in colonies suggest that efficient management requires attention to all phases of beekeeping to build and hold the maximum populations in any type of beekeeping system.

Comparative Honey Yields In Colony Management Systems

The economics of two-queen management has not been studied extensively. Farrar (4) in 1958 found that less equipment is required to produce a given crop of honey with two queens than with a single queen. Peer (10) showed that significantly less costs, time, and equipment are required per pound of honey produced than with single-queen colonies. Walton (12) in a 2-year study in New Zealand involving the equivalent of 296 colony years showed that the two-queen system consistently produced 60 to 75 percent more honey than the single-queen

¹Italic numbers in parentheses refer to Literature Cited, p. 11.

TABLE 1.—Number of colonies and honey yields for three systems of bee management, 1967 to 1974

Year	Two-queen colonies				Single-queen colonies				Package colonies			
	Col- onies	Yield			Col- onies	Yield			Col- onies	Yield		
		Avg.	Max.	Min.		Avg.	Max.	Min.		Avg.	Max.	Min.
	No.	Lb	Lb	Lb	No.	Lb	Lb	Lb	No.	Lb	Lb	Lb
1967	9	292	348	236	11	237	307	137	10	126	185	84
1968	12	266	342	217	12	169	238	63	12	106	132	67
1971	12	295	477	166	12	160	302	81	11	127	190	98
1972	2	246	288	204	8	82	170	27	—	—	—	—
1973	11	317	390	201	9	204	310	83	10	163	235	85
1974	8	224	304	175	11	138	223	60	12	75	108	22
Total or average	54	280	—	—	63	168	—	—	55	117	—	—

system ($p < 0.01$), and less hive equipment, time, and labor were needed for an equivalent amount of honey. The beekeeper's travel time under the two-queen system is less because production is more concentrated.

Table 1 shows comparative yields of honey from three systems of management—two-queen, single-queen, and package colonies—during 6 years. All colonies were in the same apiary and were headed by genetically similar hybrid stock, which was artificially inseminated. The single-queen system used was "intensive," including spring feeding of pollen supplement and 10-day reversals of brood chambers to control swarming. Yields of surplus honey on all colonies were based on the gross gain less 60 pounds allowed for winter consumption.

The average yields of two-queen colonies were 112 pounds more honey than for single-queen colonies over the 6 years observed and 163 pounds more than the average for package colonies. No attempt was made to carry colonies through several seasons under the same management. Had this been done, the two-queen colonies would have had an additional advantage because of more winter brood rearing because of their larger pollen reserve.

Records of time and labor expended on these colonies (table 2) showed that the two-queen system requires about 50 percent more time than the single-queen system; thus, the two-queen system often requires less total labor per pound of honey produced (table 1).

Two-queen colonies sometimes produce twice as much or more honey than single-queen colonies in the same apiary. Swarming occurs less with two-queen than with single-queen colonies. (Colonies are divided at start of swarm period.) Furthermore, these more populous colonies are less prone to nosema attack and better able to clean out brood

TABLE 2.—*Labor-time inputs per colony for three systems of bee management, 1967 to 1974¹*

Year	Two-queen colonies	Single-queen colonies	Package colonies
	<i>Minutes</i>	<i>Minutes</i>	<i>Minutes</i>
1967 -----	48	35	13
1968 -----	46	33	12
1971 -----	43	27	12
1972 -----	40	26	—
1973 -----	45	25	14
1974 -----	35	29	9
Average -----	43	29	12

¹All manipulations from March pollen supplement feeding to late August honey removal. (Packages were not fed supplement.)

diseases. Also, uncontrolled, nosema could considerably reduce production in package colonies (8). Nosema disease was effectively controlled here by Fumidil B in the package colonies. The quality of honey is often better (thicker and a lighter color) than from smaller colonies.

Winter loss is usually small with large colonies and with good management should be almost nonexistent. Occasional winter loss can occur because of queenlessness, a late virgin that is unable to mate, inadequate winter stores, or improper arrangement of winter stores that results in starvation. A two-queen colony goes into winter with twice as much reserve pollen in the fall (October) as a single-queen colony (4).

Organization and Management Of Two-Queen Colonies

Hive equipment

In most humid agricultural regions of the country, eight to nine 10-frame 9½-inch deep standard hive bodies are required to provide adequate brood rearing and storing space for two-queen colonies. (Many producers operate with nine frames in brood and honey bodies.) In drier areas as in some of the Western States, eight standard hive bodies may be sufficient if the honey is removed and extracted weekly during the main honey flow. Hives eight stories high can be worked satisfactorily, but few beekeepers care to operate taller hives even to obtain an increase in yield.

One-inch auger-hole entrances should be drilled in the front center of each brood chamber just below the hand holds.

Shallow hive bodies 6¾ inches deep for brood chambers and supers are advantageous for either single- or two-queen colonies with intensive

management. When such shallow equipment is used for two-queen management, 10 or 11 hive bodies are needed.

Colonies that may store more than 500 pounds of honey should be provided adequate storage capacity within a reasonable height. Such yields are not uncommon for two-queen colonies (12). A hive body 20 inches square and 6 $\frac{1}{2}$ inches deep that holds 12 frames 6 $\frac{1}{4}$ inches deep was developed by C. L. Farrar (3). It serves much better than standard 10-frame equipment for the two-queen operation. The $\frac{3}{8}$ -inch top bars of standard 5 $\frac{1}{2}$ -inch shallow frames are too light to maintain good brood combs. The most efficient management is possible when all hive bodies are uniform in size and interchangeable. The 6 $\frac{1}{4}$ -inch frames have 1 $\frac{3}{16}$ -inch deep top bars, giving necessary strength to prevent sagging.

Shallow super combs are filled and sealed more rapidly than standard combs, thus permitting more prompt removal of supers for extracting. They can then be returned for refilling, reducing the amount of equipment needed to handle the crop. Shallow square 12-frame hive bodies reduce the height of the hive and the gross weight of full supers.

Shallow 6 $\frac{1}{2}$ -inch deep equipment has advantages not only for honey production but also for overwintering large colonies. The space between top and bottom bars favors the movement of bees within the winter cluster. Standard 10-frame shallow 6 $\frac{1}{2}$ -inch deep supers can be used, provided there are a sufficient number of supers to give adequate hive capacity.

Shallow equipment is more expensive than deep equipment because more frames and hive bodies are needed for equivalent hive capacity. This disadvantage may be offset by gains from labor saved in management and higher yields from better colony control.

Various systems of two-queen management are described by Farrar (3) (one of the better known), Dunham (1), Holzberlein (5), Miller (6), Peer (10), and Walton (12). Most of the methods tend to emphasize separating brood nests, presumably to prevent queens from "fighting" across the queen excluder. This is no longer considered critical. Some earlier methods are rather complex and unnecessarily involved. The two-queen system described here is simple and still uses the normal behavior patterns of bees (9).

Colony organization and important stages of seasonal management for two-queen colonies in standard equipment are shown in figure 1 and for the square type of shallow hive in figure 2.

Strong overwintered colonies are built up to maximum strength in the early spring by feeding pollen supplement (11). In the North, the feeding starts about the first of March. The supplement is fed as fast as the colonies will take it (1 to 2 pounds per week) to insure uninterrupted brood rearing until pollen is available in the field.

During this early buildup period, the upper auger-hole flight entrances may be closed so that the bees become accustomed to using the bottom-based entrance. Thus when the second brood nest is established on top, excessive drifting away from the lower brood nest is prevented.

Overwintered colonies will have their brood nest in the upper brood chambers. If the entrances have not been lowered 2 to 4 weeks before the colonies are divided, the bees can be reorganized by interchanging the position of chambers 1-2-3-4 to position 4-3-2-1 as shown in A of figures 1 and 2 and closing all auger-hole entrances. This "reversal" of brood chambers stimulates more rapid brood expansion and allows the bees time to orient to the lower entrance position. Pollen supplement cakes can be fed even after reversal of the brood chambers by placing the cakes face up on the bottom board adjacent to the active brood.

Queens for the top divisions should arrive about 2 months before the

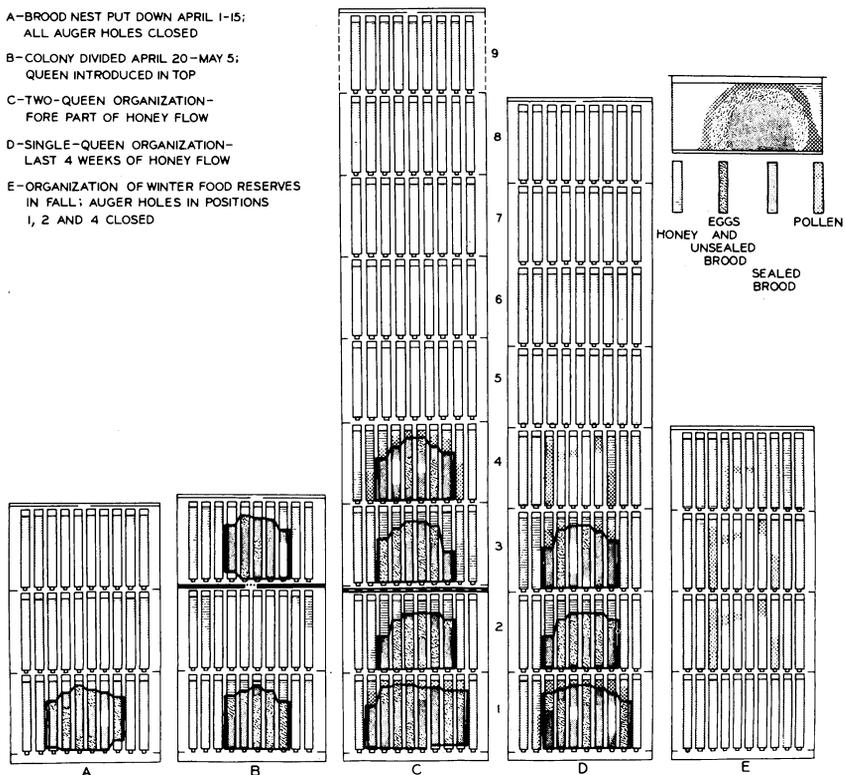


FIGURE 1.—Diagram of two-queen colony management with 10-frame standard equipment, showing the organization after manipulation.

A—BROOD NEST PUT DOWN APRIL 1-15;
ALL AUGER HOLES CLOSED

B—COLONY DIVIDED APRIL 20—MAY 5;
QUEEN INTRODUCED IN TOP

C—TWO-QUEEN ORGANIZATION—
FORE PART OF HONEY FLOW

D—SINGLE-QUEEN ORGANIZATION—
LAST 4 WEEKS OF HONEY FLOW

E—ORGANIZATION OF WINTER FOOD RESERVES
IN FALL; AUGER HOLES IN POSITIONS
1, 2, 3 AND 5 CLOSED

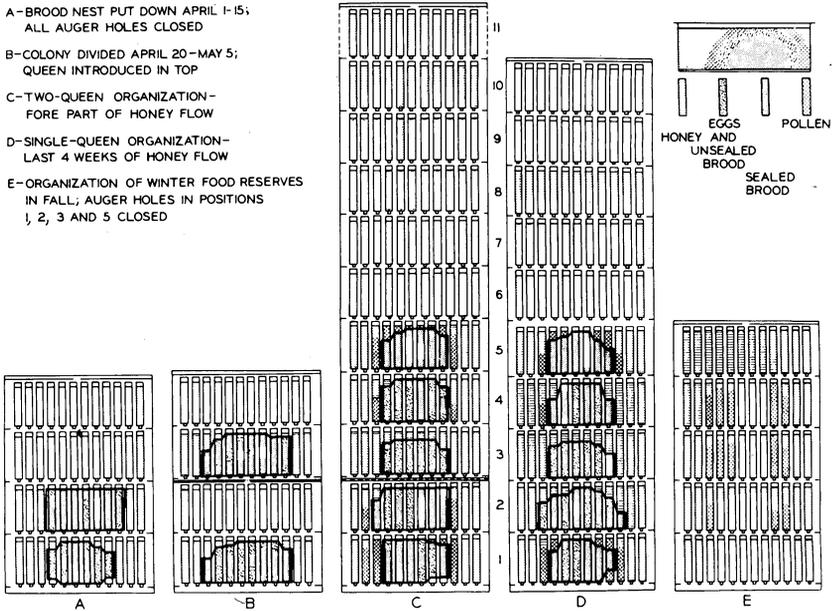


FIGURE 2.—Diagram of two-queen colony management with 12-frame shallow equipment, showing the organization after manipulation.

beginning of the major honey flow. The colonies, then, are temporarily divided into two units as shown in B of figures 1 and 2. The bottom brood chamber should contain the overwintered queen, most of the younger brood, and about half of the hive population. The division containing most of the sealed and emerging brood and the rest of the hive population remains above.

The two units are completely separated by an inner cover with the escape hole screened or closed. The upper unit is provided with an auger-hole entrance for flight.

If standard equipment is used for two-queen management, two brood chambers are necessary for the bottom and two for the top queens. However, either the modified Dadant shallow 11-frame or the Farrar square 12-frame with hive bodies $6\frac{1}{2}$ inches deep provides a much more satisfactory size of equipment. With Farrar equipment, use a minimum of two brood chambers for the bottom and three for the top.

When many colonies must be divided to receive second queens, the old queens need not be found. Make the divisions as described and about 3 days later, when the second queens are being installed, introduce the new queen to whichever unit, top or bottom, is queenless. Queen cells must be destroyed and the new queen introduced by a cage method (preferably a wire push-in cage).

At 2 weeks after introduction, generally about the time of late willow or early fruit bloom, the new queen should be laying heavily. At this time remove the dividing inner cover and replace it with a queen excluder. One excluder is enough. When weather conditions are unfavorable at the time of removal of the screened inner cover and no incoming nectar is available, the bees in both brood nests should be gorged with sugar sirup.

The arrangement of brood nest and supers is shown in C of figures 1 and 2. As additional supering is required, manipulation is similar to that of single-queen colonies except that the larger two-queen populations require considerably more room. When a single-queen colony is receiving one super, a two-queen colony may require two or even three empty supers at one time.

Brood nests above and below the queen excluder should be reversed about every 7 to 10 days until about 4 weeks before the expected end of the flow. The honey crop on the colony may be so heavy at this time as to preclude any manipulations of brood nests. From this time on, brood nest reversal is discontinued and more attention given to supering and honey removal as the needs of the colony dictate. Supers should be extracted as soon as they are finished and replaced on the colonies as needed. Make sure the colonies have adequate room at all times for storing the crop.

"Wet" supers returned from the extractor are always placed above partially filled supers, never directly over the top brood nest because they are attractive to the queen. If such supers are placed directly over the top brood nest, a second queen excluder must be used in that position.

The top brood nest may tend to become honey bound. If this occurs, reverse the entire upper and lower brood nests around the queen excluder. This puts the top honey-bound brood nest on the bottom board and the lighter brood nest above the excluder. In such an operation the top queen must not be allowed to climb up into the supers above the upper brood nest.

Theoretically, the advantage of having a second queen no longer applies when about a month of honey flow remains. Eggs laid from this time on require 3 weeks to become adult bees and 2 weeks beyond this to become foragers, at which time the flow is past. However, entering the brood nests is not practical during the middle of the flow to remove the queen excluder and unite brood nests. The colonies are then fully supered and entering the brood nest for manipulations is difficult.

In practice, leaving the colony as a two-queen unit well into the end of the flow is advantageous. The time to unite back to a single-queen status is after the bulk of the crop is removed from the colony, as in D

of figures 1 and 2. More honey may be lost by uniting the brood nests too early than a little too late. By this time some of the colonies may already have disposed of one queen.

When two-queen colonies are reunited to single-queen status by removing the queen excluder, it is not uncommon for upper and lower queens to remain for a considerable time. From this time until the following April, the colony functions as a single-queen unit.

Each beekeeper can modify his operation to comfortably operate with a two-queen advantage suited to his locality and needs. Some may wish to use a two-queen package system (two packages, one above the other (10)). Others may find the system primarily useful for a requeening operation, benefiting from a shorter period of actual two-queen operation.

Queen supersedure and replacements

Queen supersedure is usually less evident in two-queen than in single-queen colonies. This occurrence takes place because when one queen begins to fail and thus produces less queen substance, which is the chemical that inhibits queen cell building, the other queen is still producing an adequate amount of the substance for the whole colony. Either the top or bottom unit then goes queenless, but the bees do not usually build cells.

Where the two-queen system is practiced in the larger commercial operations, re-establishing second queens in colonies that lose one queen is uneconomical. Proportionately too much time is required for a small percentage of the colonies. For those smaller operators who wish to replace lost queens in two-queen units, they must again start the two-queen system from the beginning.

Swarming and increase

Swarming is not a problem when good queens are maintained in broodnests and space for brood expansion and timely manipulations stimulate honey storage. If the colony is allowed to swarm, the loss of bees is considerable. The wings of both queens should be clipped. If the colony attempts to swarm, both queens may be found in the lower brood nest. One may be returned to the upper broodnest when the conditions that caused the swarming have been corrected.

The best way to deal with such colonies that have shrunken queens is to make a "shook swarm" with one queen on a new set of combs. The other queen, with all the brood and adhering bees, can be set to one side to allow many of the field bees to drift back to the original hive location. When both queens are again expanded and laying normally, the hives can be recombined in a manner suitable to the stage of the honey flow or used to make more colonies.

To make increase from two-queen colonies is not a good policy because the advantage of large pollen reserves for wintering, characteristic of two-queen colonies, may be lost. If conditions are favorable for abundant pollen storage, the two-queen organization can be retained to the end of the honey flow. Such colonies can be wintered as double colonies by removing the separating queen excluder and by placing at least 60 pounds of honey in dark combs above the lower broodnest. An inner cover with the escape hole closed or screened should separate the top and bottom broodnests. The bottom board entrance should be reduced or closed, and a single 1-inch auger-hole entrance used for each of the separated colonies. The winter clusters will mutually benefit from heat radiated through the separating inner cover.

Strong nuclei or one-story divisions with young queens may be overwintered above strong colonies similar to the overwintering of double units for increase described above. The purpose here, however, would be to simply overwinter one extra queen for each two-queen colony and enable the beekeeper to start his two-queen system without purchasing new queens in the spring. This is a dependable means of overwintering extra queens with less risk than a queen "bank" system.

Overwintering losses are virtually nonexistent when using the two-queen system. When losses do occur, they are usually in the early spring when large populations may starve if insufficient winter honey supplies were not left with the colonies in the fall to compensate for more intense winter brood rearing. Larger populations, larger pollen reserves, and resultant use of more honey in brood rearing dictate that the beekeeper leave 90 to 100 pounds of honey in the fall to carry the colony through until settled warm weather in the spring.

In the spring a weak colony may be set above a good colony in the manner used to organize a two-queen colony (division with an excluder beneath the weak colony in place of the inner cover). Unless a good spring nectar flow is in progress, the bees of both colonies should be gorged with sugar sirup when they are set together. When the weak colony has a good queen, some bees from the lower colony will move up and permit this queen to expand brood rearing. When it has a poor queen, nothing is lost as would be the case if brood or bees from a good colony were taken to strengthen a weak colony.

Discussion

The two-queen system of colony management is based on the principle that honey production per unit number of bees increases as the population increases. Strong colonies not only produce more honey but they do it more efficiently than less populous colonies. The beekeeper gives more attention to queen quality than with most other

systems of management. Two-queen colonies have a large winter pollen reserve, as much as 300 square inches more stored pollen, enabling colonies to raise more young bees during the winter.

Less hive equipment is needed to produce a given crop of honey than is customary for single-queen management. Standard 10-frame hive equipment has limitations for two-queen management, however.

Key manipulations for two-queen management:

1. Build maximum populations in overwintered colonies by feeding pollen supplement in early spring.
2. Work the winter upper flight entrances gradually to the bottom.
3. Introduce second queens to divisions placed above inner covers with escape holes screened 2 months before the major honey flow. Divisions have auger-hole entrances.
4. Substitute queen excluders for division boards 2 weeks after introduction of the new queens.
5. Reverse brood chambers within each brood nest at 7- to 10-day intervals until about 4 weeks before the expected end of the flow.
6. Reunite to single-queen status after the bulk of the crop is removed.

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