A COMPARISON OF EQUAL DIVIDING, PACKAGE BOX, AND UNDIVIDED COLONIES AS OBTAINED BY HONEY PRODUCTION AND AMOUNT OF SCALE GROWTH

by

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INTRODUCTION

The majority of the beekeepers in the United States are primarily interested in honey production. They manage their bees according to weather, availability of nectar-producing plants and time of blooming, and individual methods of beekeeping management. In general, beekeeping practices fall into two groups, "intensive" and "extensive" beekeeping. In the first one, the beekeeper uses more of his skill and time with a relative small number of colonies in order to produce the maximum yield of honey. In the latter way, he gives less time and skill to each colony but he manages many more colonies than in the first method, so he depends on a larger number of colonies to obtain the honey crop rather than the better management of fewer colonies.

Beekeepers, especially those who practice the extensive type of management, lose a number of colonies every year from winter loss, diseases, and improper management. The next season, they need to increase the size of their apiary or apiaries to the limit they can manage. Sometimes they wish to expand their business by increasing the number of colonies. Some of them make increase by dividing the strong colonies in the spring and others do so by buying package bees. Some of these practices, for a given locality, are more applicable than others because of the availability of nectar-producing plants, favorable weather conditions, and the length of the period possible for colony population increase.

The various beekeeping practices can be summarized as follows:

1. Maintenance of honeybee colonies throughout the year. Increase in the number of colonies can be made by (1) division, (2) buying package bees, and (3) the capture of swarms.

2. Maintenance of honeybee colonies only for the active or growing season. The bees are killed in the fall and the colonies are reestablished in the spring by buying package bees.

3. Management of colonies in any of the above two groups either as one-queen or two-queen colonies. There are, however, some other practices which are combinations of two or more of these methods.

Many beekeepers in the northern states and Canada advocate killing the colonies in the fall and restocking the hives with packages of bees in the spring. The winter, there, is very severe and colonies need much care and management in order to overwinter successfuly. They believe that by killing the colonies in the fall, they will save the honey required for fall and winter feeding, time, and labor involved in preparing colonies for winter. Many others do not agree with this idea and recommend overwintering the colonies, claiming that established colonies are better honey-producers than colonies produced from package bees.

The purpose of this study was to compare different groups of colonies in their development and productivity for this locality during the active season of 1954. The groups of colonies were equal divisions, two-pound packages, three-pound packages, and overwintered undivided colonies. These groups, alone

or in combination, represent the various common beekeeping practices for honey production.

Because of the limited time, the two-queen colony group was discarded from this study.

REVIEW OF LITERATURE

Many workers in beekeeping have tried experiments in different regions and years to compare the productivity of two or more of the various groups of colonies, divisions, packages of different sizes and undivided colonies to find out the most economic method of beekeeping practices for honey production. The results obtained have not been similar because of such variable factors as variations in latitude, the abundance of nectar and pollen-producing plants, time of the main nectar flow or flows, length of colony-population-increase period, the skill in management, strain of bees and weather conditions.

Date of Installation of Package Bees

Sanders (1938), Cale (1940), Deyell (1944, 1950), and Rhapstock (1949) pointed out the importance of installing package bees at the right time. Sanders (1938) and Cale (1940) stated that if package bees are installed too early, there will be a serious drain on the vitality of the bees before the colonies become established. If installed too late, they will not have enough time to make the maximum colony population increase before the timeof the first main nectarflow. Farrar (1952) reported that the earlier packages are obtained, the more likely they are to

have Nosema, but the gain in the period of increase is a distinct advantage, if infection is not too severe.

Woodman and Dadant (1935), Kelty (1948), Martin (1952), and le Maistre (1953) stated that the period of colony population increase is ten weeks. Accordingly, packages should be installed ten weeks before the first main nectarflow. Dunham (1938) and Miel (1944a) reported that under average conditions, a two-pound package requires ten weeks to increase to storing strength; a three-pound package requires eight weeks (eight to nine according to Dunham (1938)). Farrar and Schaefer (1939) and Farrar (1944) stated that a package colony requires ten to twelve weeks to reach its maximum population. Doyell (1944) reported that eight or more weeks are required for a package to develop into a good storing colony. Doyell (1950) stated that nine to ten weeks is the colony-population increase period. He recommended that packages be established at the time of the early available pollen in the field in order to stimulate queens to lay and to provide food for colony development. Farrar (1952) reported that, under favorable conditions (prolific queen, supported by healthy bees, ample comb space, and abundant stores of pollen and honey) packages require ten to twelve weeks to reach their maximum strength. Farrar et al. (1954) reported that packages should be established eight to twelve weeks before the major nectarflow.

Sanders (1938) reported that in Manitoba, yellow and white sweet clover, which are the main sources of nectar, bloom in June and July, so packages should be established as early as

possible in the spring in order not to miss the main nectarflow. He considers the first week of May as the right time for establishment. Kelty (1948) stated that clovers, particularly alsike and white, are the main surplus nectar plants in central Michigan. Package bees should be installed on about April 10. Colony population increase period will be about ten weeks as the main nectarflow starts June 20 to 25. In an anonymous article (1947), it was stated that April 15 is the standard date for establishment of packages in the middle states such as Ohio, Indiana, Illinois and Iowa. If they are installed in April in the far north, they will produce the maximum working force where further south they cannot get such results.

Martin (1952) reported that, if combs of pollen and honey are used, packages can be established ten weeks before the main nectarflow starts; whereas if foundation is to be used, packages should be established seven weeks before the beginning of the nectarflow. That is because of the early spring weather conditions characteristic of Michigan. It is considered that the great chance of losing packages hived on foundation in early spring offsets the desirability of early purchase.

Other Factors Affecting Success with Packages

Food. Woodman and Dadant (1935), Farrar and Schaefer (1939), Cale (1940), Miel (1944a), Farrar (1944, 1952), Deyell (1950), and Farrar et al. (1954) considered that abundant stores of pollen and honey are required for the development of package

bee colonies. Lysne (1949) and Farrar et al. (1954) reported that if two-pound packages are installed on full combs of pollen and honey they will develop into productive colonies by the time of the main nectarflow. Knutson (1940) stated that if packages are supplied abundantly with pollen and honey they could be hived earlier than ordinary and would have enough time for their development. That is the reason why overwintered colonies move ahead of package colonies, because they have enough pollen to rear brood quite early. Lininger (1945) stated that, if packages are hived on drawn combs and fed sufficiently with sugar syrup, they will develop into productive colonies. Harrison (1945) reported that if package bees are established in early spring on full combs of pollen and fed sugar syrup, they compete successfully with overwintered colonies. Farrar (1952) mentioned that if package colonies are not fed sufficiently, their development will be dependent on favorable weather conditions. Farrar and Schaefer (1939) and Farrar et al. (1954) stressed the generous feeding of packages hived on foundation until they became established.

Queens. Woodman and Dadant (1935), Miel (1944a), Kelty (1948), VanderPyl (1949), Rhapstock (1949), Farrar (1952), and Farrar et al. (1954) mentioned that a prolific queen is important for development of package bee colonies. Kelty (1949) found that packages with uncaged queens, produced larger honey crops than those of caged queens. Farrar and Schaefer (1939) summarized the classes or groups under which losses of queens in package bees as follows:

"Loss during shipment and introduction, loss

> due to poor queens (abnormal, drone layers, queens producing brood of low quality . . . etc.), loss due to dwindling populations (short-lived package bees, drifting, a lack of pollen for brood rearing, weather conditions . . . etc.), and loss from manipulations."

Farrar (1952) and Farrar et al. (1954) recommended buying surplus queens and introducing them to nuclei to make queen reservoirs. These extra queens are to replace queens that prove inferior and to be introduced to queenless colonies which lose their queens in introduction or supersedure. Healthy bees and ample space for bee clustering and brood rearing are also essentials. Cale (1940), Niel (1944a), Farrar (1944) and Farrar et al. (1954) stressed the idea that the strain of bees should be selected carefully.

Management. Dunham (1936), Niel (1944a), Kelty (1948), Farrar (1952), Hansen (1952), and Farrar et al. (1954) stated that with intelligent care and good management, it is possible to obtain the maximum crop from package bee colonies. Niel (1944a) and Kelty (1948) reported that good care in transit and during installation is one of the important factors that affect success with package bee colonies. Harrison (1945) stated that if packages can be shipped six weeks or more ahead of the apple bloom and if they can travel safely during freezing weather, they can be hived and develop to be as strong colonies as the overwintered ones.

Cale (1940) and Deyell (1950) found that there will come a time in the development of package bee colonies when some of the original bees that come with the packages begin to die with no emerging young bees. This is called the critical period. Anony-

mous article (1947), Doyell (1950) and Farrar et al. (1954) stated that a package bee colony should be "boosted," at the critical time by introducing combs of emerging brood and young bees. Cale (1940) reported that bees must be aided at this period by introducing a comb of emerging brood. Whiting (1936) and Hansen (1949) have recommended package bee colonies be given combs of emerging brood which will result in increasing their yields considerably.

Weather. Kelty (1948) found that the weather has a great effect on the establishment of package bee colonies. When weather conditions are unfavorable at installation time, less drifting will result. Weather conditions, also, affect the availability of pollen and nectar in the field in early spring. Farrar et al. (1954) reported that cool nights restrict brood nest expansion thus chilling brood in early spring. Miel (1944a) recommends windbreaks to shelter package colonies at the time of establishment.

Age of Bees. Miel (1944b), Bessonet (1946), and Farrar et al. (1954) mentioned that package bees should contain only young bees as the old bees are seldom of any value. Bessonet (1946) reported that development of package bee colonies depends on young worker bees. Packages containing drones are of less value.

Other Factors. le Maistre (1953) considers the following four factors as important for establishment and progress of package colonies: the date of the main nectarflow, size of the

field force necessary to gather the available nectar, time required to produce a field bee and the activity of queens under Alberta spring conditions. Woodman and Dadant (1935) recommended a good location with abundant major and minor nectar-producing plants for the package colonies.

Comparison of Various Groups of Colonies[1]

Size of Package. Bell (1932), Farrar (1944, 1952), and Martin (1952) consider differences in sizes of packages as of minor importance. Most of the original bees die the third week after installation. A two-pound package, if properly managed, will develop to a full strength colony in practically the same time as a larger package. Farrar and Schaefer (1939) found that packages of less than two-pound size develop slowly, but of two to two and one half pounds size develop as fast as larger packages, if they are well fed during the establishment period. Farrar and Schaefer (1939) and Farrar et al. (1954) consider the two-pound package, provided with abundant stores and hived 10-12 weeks before the nectarflow, as better practice than larger package size installed later in the season. Farrar (1944, 1952), and Farrar et al. (1954) prefer the three-pound package where comb foundation is to be used. le Maistre (1948) and Martin (1952) reported that the two-pound package gave good results,

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[1]These were package colonies of different sizes, divisions and undivided overwintered colonies.

if installed at the right time; but stated that if packages are to be installed later than the right time, the three-pound size will give better results. Dunham (1938) and Munro (1940) mentioned that the two-pound package is the preferred size by most beekeepers. Kelty (1948) found that the larger size was better for honey production in packages, if headed by equally prolific queens.

Doyell (1932, 1944, 1950), and Dunham (1938) stated that in areas of late nectarflow such as sweet clover, two-pound packages produce good crops. According to Doyell (1932, 1944, 1950) the three-pound packages are preferable in areas of early nectarflow such as white and alsike clovers. Lininger (1945) found that three-pound packages give better results than two-pound packages.

Overwintered vs. Package Colonies. In comparing undivided or overwintered colonies with package colonies, it is found that beekeepers in the United States are of different opinions because of variable factors that affect success with each group of colonies. Gilbert (1935), Whiting (1936), Filmer (1937), Munro (1940), Braun (1941, 1947), Johnson (1945), Kinrad (1945), Martin (1948), Dodge (1949), Mcblad (1949), Hansen (1949), Keller (1949), Miles (1949), Rhapstock (1949), Starnes (1949), Hydak (1950), and Chamberlin (1952) reported that overwintered colonies are better honey producers and more profitable than package bee colonies. Starnes (1949) mentioned that both overwintered and package colonies produce honey; but under poor

weather conditions, package colonies produce poor crops.

Munro (1940), Kreklaw (1949), and Hansen (1952) stated that with good management, it is possible to make as large a crop with package colonies as with overwintered colonies with the advantage of storing equipment in winter. In an anonymous article (1947) it was stated that when package bees are hived on combs with abundant stores, they will produce as much as overwintered colonies. If they are aided with combs of brood and bees, their honey production will be higher. Keller (1949) and Rhapstock (1949) found that package colonies in areas of late nectarflow give better results than the overwintered ones. Dunham (1938) found that package bee colonies compete with overwintered ones in sweet clover areas, which is considered a late nectarflow, while in alsike clover areas, which is an early nectarflow, package colonies produced about one half the crop of that of overwintered colonies. Gilbert (1935) and Hydak (1950) found that if package colonies are managed for the active season only and killed in the fall, their total honey production is more than that of the overwintered colonies. Hydak (1950) stated that under certain conditions, package colonies may produce a larger crop than overwintered ones.

Braun (1936, 1941) summarized uses, advantages, and cost of package bees. Advantages of package bees are: easier to manipulate especially for beginners; can be used to replace winter and disease losses, can be used to increase number of colonies, to

strengthen weak colonies, for pollination purposes; they increase total volume of honey; and swarming is not a problem with package bee colonies. Costs of packages include cost of packages and transportation, value of loss in transportation including loss of queens in introduction, loss of queens in supersedure, cost of labor involved for establishment, and cost of feed and feeding. Their total profit will be the total honey crop produced plus value of increase made from packages less total cost. Braun (1941) mentioned the disadvantages of packages as fluctuating purchase price, need of big outlay of ready cash, no definite time for their arrival, high percentage of queen supersedure and cost of spring feeding.

According to Braun (1941), advantages of overwintered colonies are: increased population in early spring, strong overwintered colonies can be divided to make increase or loss replacement; they produce larger crop on the average than the package bees; give stability to beekeeping industry; there is no big outlay of ready cash needed, and they do not need much work or attention during busy, early season. Their disadvantages are: winter loss averages 9 1/2 percent annually; labor costs little higher than that of package colonies and the latter is spread over a twelve-month period instead of six-months as with package colonies, they require more labor and attention to overcome swarming troubles; more detailed attention is required during harvest season; more depreciation on equipment; more forethought is required; and the high investment of equipment. Braun

(1936) reported that cost of overwintered colonies are: labor of preparing colonies for winter; cost of fall, winter and spring feeding; interest on cost of packing cases; labor of unpacking in the spring; and loss during winter. Total profit will be the value of total honey crop produced plus value of increase made, less total cost.

Woodman and Dadant (1935), Whiting (1936), Long (1944), Keller (1949), Kreklaw (1949), Lycne (1949) and Whiting (1953) mentioned that swarm control is not an important problem with package colonies. Munro (1940) and Braun (1945, 1947) reported that package colonies are uniform units and do not require unnecessary work or individual attention.

Parker and Keck (1928), Gilbert (1935), Braun (1936, 1941), Johnson (1945), Kinrad (1945), Chamberlin (1952), and White (1953) stated that packages can be used as a source of increase. Chamberlin (1952) considers the packages as a good source of replacement, and of value in adding new strains of bees, expanding size of apiaries and trying new strains and races as well as saving the trouble of winter preparation. Munro (1940) and Sanders (1940) stated that requeening colonies, especially if queens are of good quality, is one of the advantages of packages in addition to saving troubles and time of wintering.

Lininger (1945), Rhapstock (1949), and Starnes (1949) mentioned that queen supersedure in package colonies is still a serious problem. Cale (1940) stated that supersedure starts at the critical time of the development of package bee colonies,

which is about the third week after installation. He recommended adding one comb of emerging brood to the package colony at this time to overcome queen supersedure.

Lininger (1945), Rhapstock (1949) and Long (1952) stated that packages were factors in introduction of adult diseases from the south. Long (1944) and Lininger (1945) attributed some failure of package colonies to heavy Nosema infection. Farrar et al. (1954) considered disease freedom in packages as an essential in their development.

According to VanderFyl (1949) and Farrar et al. (1954) package colonies develop and grow unevenly in the different seasons. There is a big variation in their growth and consequently the crop obtained.

Woodman and Dadant (1935), Braun (1941), Martin (1948), and Hydak (1950) stated that by overwintering colonies, the beekeeper does not need a big outlay of cash to buy packages. Wintering-over bees cost the beekeeper winter loss and feed. According to Braun (1941), Martin (1948) and Hydak (1950) overwintering colonies of bees give more stability to the beekeeping industry.

Sanders (1940) and Newell (1950a) reported that overwintered colonies reach peak of population early in the season, resulting in swarming troubles. They require extra work and attention.

Woodman and Dadant (1935) and Rhapstock (1949) mentioned that cost of sugar or honey required for wintering as against the cost of packages is one of the important factors that should

be taken into consideration in the advisability of buying packages instead of overwintering.

Munro (1940) recommended killing colonies in the fall in cases of lack of winter stores and wintering quarters. Braun (1941) mentioned that killing colonies may be justified under certain conditions, such as when colonies are heavily infected with American foulbrood, or when they do not gather enough honey for their overwintering when the price of sugar is high. Johnson (1945) considers weak colonies in the fall as useless, and it is better if they are killed in the fall and replaced with package bees in the spring. Kinrad (1945) stated that in areas of severe and uncertain winter, colonies should be killed in the fall. According to Martin (1948), many beekeepers in Manitoba kill their colonies in the fall and buy package bees the next spring because of the severe winter; period of colony population increase is sufficient that package colonies can develop into strong units that produce good honey crops, saving time and trouble of wintering and preparing colonies for winter.

Divisions. Parker and Keck (1928) reported that divisions can be used as a source of increasing the number of colonies. According to Braun (1941, 1945), Shoemaker (1946), and Newell (1950a), dividing overwintered colonies early in spring, is profitable and resulting in good honey-producing colonies. Newell (1950b) stated that if overwintered colonies are divided in areas of late nectarflow (10 to 12 weeks after making divisions), this division will increase honey production, increase

number of colonies and reduce swarming. But if they are divided in locations of early nectarflow, this will result in smaller honey crops as division colonies will not have enough time to develop into productive units by the time of the beginning of nectarflow. Braun (1945, 1947) and Newell (1950a) pointed out that divisions are uniform units, and they do not require individual attention or unnecessary work to reduce swarming. Braun (1941, 1945, 1947) and Johnson (1945) stated that divisions may be more profitable than package bees. Johnson (1945) used small nuclei with two or three combs for increase purposes, but he discontinued this method because of more chances of spreading American foulbrood.

Sanders (1940), and Johnson (1945) recommended the division of strong overwintered colonies and providing each division with a young queen, rather than buying package bees. Such divisions produce as much honey as a two-pound package with less expenses. Braun (1941) preferred three-frame overwintered nuclei with new queens to two-pound packages because they are more profitable.

MATERIALS AND METHODS

The materials used were two-pound packages, three-pound packages, equal divisions, and undivided overwintered colonies in Dadant sized hives. There were two colonies in each group.

The four packages were bought from the same source in the south and arrived in Manhattan on April 1st. After being

received, the packages were kept in a dark and cool room of about 50°F for about one hour. In each package, there was one caged queen, with some attendants, suspended in the package. The queen cages were removed from the packages first. The queens were clipped and marked in preparation for introduction. The package bees were sprayed with warm sugar syrup until they became gorged. Each brood chamber was supplied with six combs of honey and pollen and were placed on one side. The bees were partially shaken, onto the combs. The package with the remaining bees was placed in the hive body, beside the combs. A caged queen, without attendants, was introduced by squeezing the queen cage between the tops of two frames, near the package cage where most of the bees were clustered. In order to secure the rapid release of the queen, a hole about the size of a bee space was made through the queen cage candy. Extra queens were introduced to nuclei of three combs, each to be a queen reservoir and to be united to colonies with inferior queens, or to queenless colonies that lose their queens in introduction or supersedure.

The divisions were made by dividing adult bees, brood, honey and pollen of an overwintered colony into two equal divisions. Each division was hived in a hive with combs of pollen and honey. Divided overwintered colony was, prior to division, in as good condition and about the same strength as the check, undivided colonies.

A new clipped and marked queen was introduced into each

EXPLANATION OF PLATE I

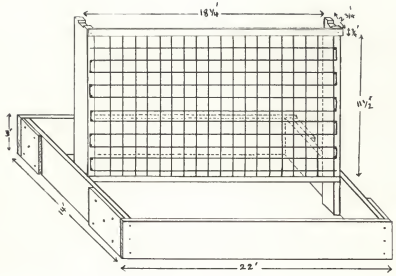
A queen Reservoir

PLATE I

EXPLANATION OF PLATE II

The brood counter, Dadant-frame size
divided into square inches.

PLATE II



unit of the divisions and into the undivided colonies by the same method mentioned above in the description of installation of package colonies. The undivided colonies were dequeened before introducing new queens. Queens of all units were accepted successfully.

Installation of package bees, divisions, and introduction of new queens were accomplished on April 1st. Dadant hives were used for hiving colonies of this experiment. Because of the cool weather in the early spring, windbreaks were used to protect bees and brood from being chilled.

Colonies and queen reservoirs were fed with an abundance of honey and pollen and provided with ample room for bee clustering and brood rearing. Pollen and nectar were also available in very good quantities in the field at the time of establishment especially when weather conditions were favorable for bee flight.

Queens started laying within few days after introduction and colonies developed accordingly.

Relative development of the colonies was determined by comparing square inches of worker sealed brood at 12-day intervals. Counts were taken regularly on the twelfth day, except under unfavorable weather conditions when counts were taken the following (thirteenth) day. The brood counter (Plate I) was used for measuring sealed brood.

There were two nectarflows this season as determined by three independent colonies on scales which were maintained to make records of gain or loss. The first one was from May 30 to

July 1, 1954, mainly from yellow and white sweet clovers which represent the early nectarflow; and the second one was from July 26 to August 31, 1954, mainly from alfalfa, which represents the late nectarflow. The honey, in supers, produced by each colony from the early nectarflow was extracted and weighed separately from that of the late nectarflow. Interruption of development of two colonies (division colony no. 21 and undivided colony no. 23) resulted from queen loss, had its adverse effect on their honey production from late nectarflow only, and, of course, on total honey production. As a result, the average amount of extracted honey per colony produced by each group of colonies during the early nectarflow was used for comparison. For comparison of productivity from late nectarflow and for total production, the colony of higher production in each of these two groups was used to represent its respective group.

RESULTS AND DISCUSSION

Results obtained are shown by Tables 1, 2, 3, 4, and 5. Graphic representation of Table 1 is given in Plate III, and of Table 2 in Plate IV.

Comparative Brood Development During Early Season (Through late May)

Development of undivided, check colonies was more rapid than that of the other groups of colonies as demonstrated by Table 1 and Plate III, and Table 2 and Plate IV. In Table 1

Table 1. Square inches of worker sealed brood in the best* colony from two-pound and three-pound packages, equally divided and undivided colonies. 1954.

Colony group	Dates and square inches of sealed brood											
	4/17	4/29	5/11	5/23	6/3	6/16	6/28	7/10	7/22	8/3	8/15	8/27
2-lb. pkg.	264	541	450	710½	758	763½	707½	662¾	523½	499½	558	395
3-lb. pkg.	226	468	454¾	620	689½	758½	648½	602½	421½	461½	598½	457½
Division	73	530	710	714¼	712	563	609½	571	449	534½	602	413
Undivided	358	700¾	785	699	729½	367	626¾	679	585½	607	673½	352

* Because two colonies lost their queens and had interrupted development, selection of the best colony in each group was used in this table for comparison.

EXPLANATION OF PLATE III

Comparative development of the four groups of colonies during the active season of 1954.

PLATE III

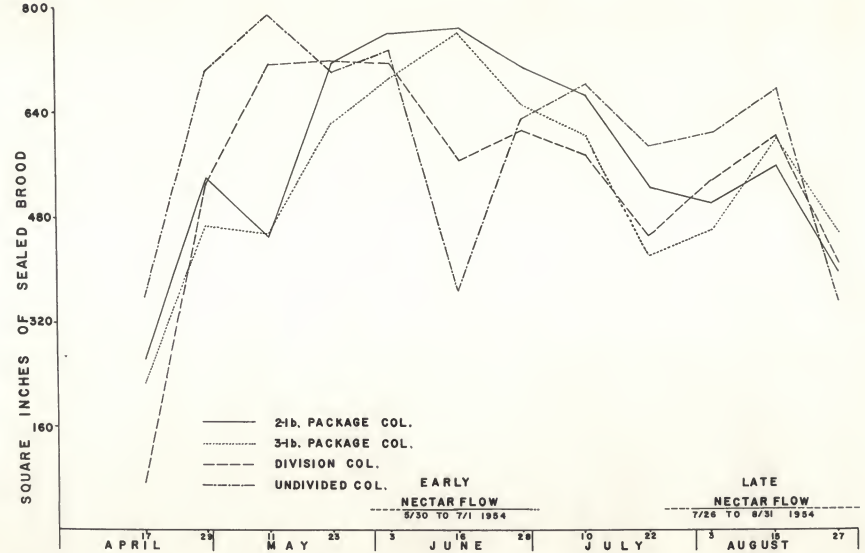

800
640
480
320
160
SQUARE INCHES OF SEALED BROOD
2-lb. PACKAGE COL.
3-lb. PACKAGE COL.
DIVISION COL.
UNDIVIDED COL.
EARLY
NECTAR FLOW
5/30 TO 7/1 1954
LATE
NECTAR FLOW
7/26 TO 8/31 1954
17
29
11
23
5
16
28
10
22
3
15
27
APRIL
MAY
JUNE
JULY
AUGUST

Table 2. Square inches of worker sealed brood of the two colonies that lost their queens during the active season of 1954.

Colony group and number	Dates and square inches of sealed brood										
	4/17	4/29	5/11	5/23	6/3	6/16	6/28	7/10	7/22	8/3	8/15	8/27
21 (Division)	58	610	652	636	798	694½	440½	96½	618½	699	729½	420½
23 (Undivided)	404	647½	761½	655½	655½	476	97½	428½	431	429½	453	397½

Table 3. Comparison of various groups of colonies in honey production during early and late major nectarflows of 1954, in pounds.

Colony group	Pounds of extracted honey produced	
	Early nectarflow (average)	Late nectarflow (better colony)
2-pound package	135¾	86¾
3-pound package	110⅛	77¼
Division	139¼	62½
Undivided	145½	81

EXPLANATION OF PLATE IV

Comparative development of the two colonies that lost their queens during the active season of 1954. Asterisk indicates last time queen was seen.

PLATE IV

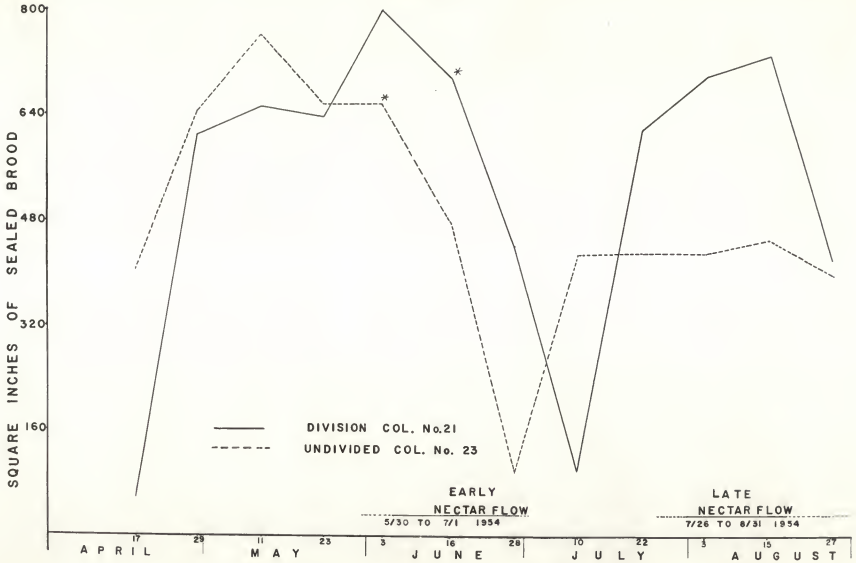

800
640
480
320
160
SQUARE INCHES OF SEALED BROOD
DIVISION COL. No.21
UNDIVIDED COL. No. 23
EARLY
NECTAR FLOW
5/30 TO 7/1 1954
LATE
NECTAR FLOW
7/26 TO 8/31 1954
17
29
11
23
3
16
28
10
22
5
15
27
APRIL
MAY
JUNE
JULY
AUGUST

Table 4. Amounts of extracted honey produced by the better colonies in the groups during 1954, in pounds.

Colony group	Pounds of extracted honey produced: Early nectarflow	Late nectarflow	Honey left in the hive bodies*	Total production	Total production if colonies are killed in the fall**	Total production if colonies are overwintered
2-lb. pkg.	148 3/4	86 3/4	68 1/2	304	259	229
3-lb. pkg.	114 1/2	77 1/4	66 3/4	258 1/2	210 1/2	180 1/2
Division	154 1/2	62 1/2	76 1/2	293 1/4	248 1/4	218 1/4
Undivided	155 1/2	81	60 3/4	297 1/4	252 1/4	222 1/4

* The figures in this column represent honey, pollen, and bees. Some of this honey and pollen were gathered by bees during the first nectarflow; some others during the late nectarflow and the remainder was left from stores given to colonies at time of establishment in early spring.

** Overwintered colonies need 30 pounds of honey for winter feed and 45 pounds for spring feed, whereas, colonies killed in the fall need only 45 pounds of honey for re-establishment the following spring.

Table 5. Amounts of extracted honey produced by the two colonies that lost their queens.

Colony group	Pounds of extracted honey produced: Early nectarflow	Late nectarflow
No. 21 (Division)	124 1/4	62
No. 23 (Undivided)	135 1/2	51 1/4

EXPLANATION OF PLATE V

Fig. 1. Two-pound package colonies during the early nectarflow, June 24, 1954. (Colonies' numbers from left to right 18, 17.)

Fig. 2. Three-pound package colonies during the early nectarflow, June 24, 1954. (Colonies' numbers from left to right 14, 13.)

PLATE V

EXPLANATION OF PLATE VI

Fig. 1. Division colonies during the early nectarflow, June 24, 1954. (Colonies' numbers from left to right 22, 21.)

Fig. 2. Undivided overwintered colonies during the early nectarflow, June 24, 1954. (Colonies' numbers from left to right 24, 23.)

PLATE VI

it will be noted that the undivided colony exceeded the division colonies through June 3, except for a slight reversal during the May 23 reading. Table 2 also showed this trend as would be expected, since the queens were not lost until later in the season, as evidenced by a greater amount of sealed brood through June 3. This advantage by the undivided colony over other groups would be expected since undivided colonies are well supplied with nurse bees to take care of much more brood as compared to the other groups, which explains why overwintering colonies tend to reach the peak of production earlier than package or division colonies.

Division colonies produced more sealed brood than packages, as evidenced by Table 1 and Plate III. Although this trend was not apparent through the April 29 reading, sizable increases by the division colonies were apparent on May 11 and 23, as would be expected since nurse bees were present in greater numbers than in the packages.

Two-pound packages generally produced more sealed brood than the three-pound packages with the exception of a slight reversal on May 11.

Comparative Productivity During Mid-Season (Through June)

Sealed Brood: Development of undivided, check colonies, and to a lesser extent in the division colonies, dropped considerably during the early nectarflow, May 30 to July 1, despite apparently sufficient room for queen activities and nectar

storage (Table 1 and Plate III). It will be noted that the undivided colonies had produced 367 as compared to 563 square inches by the division colonies. The decrease in amount of sealed brood from May 23 to June 16 was caused by the restricted egg laying of the queen due to the deposit of nectar in cells of the brood nest from which bees had recently emerged.

In the case of the two colonies which lost their queens (Table 2 and Plate IV), no comparison in this respect can be made.

Two-pound packages generally developed faster and produced more sealed brood than the other three groups during the June 3, 16, and 28 readings (Table 1 and Plate III). This is evidence that brood production of package bees or other colonies depend upon queen performance rather than the size of the population of the colony during early spring and mid-season when all conditions are the same.

Honey Production: Production (average early nectarflow) of the undivided, check colonies was higher (145 1/2 pounds) as compared to the divisions (139 1/4 pounds), three-pound packages (119 1/8 pounds), and two-pound packages (135 3/4 pounds), (Table 3). The larger amount of honey produced by the undivided colonies, in spite of the decrease in sealed brood area during the early nectarflow, may be explained as follows: A period of 21 to 33 days is required for a bee in the sealed brood stage to become a field bee.

Comparative Productivity During Late Season
(Through July and August)

Sealed Brood: Development of undivided, check colonies, was somewhat above that of the other three groups, (Table 1 and Plate III). The area of sealed brood in all cases dropped rather sharply following the cessation of the early nectarflow and the occurrence of extremely high temperatures and dry weather from July 1 to 22 which weather affected the availability of pollen and nectar adversely. The two-pound package group finally decreased to 558 square inches, the lowest of all groups on August 15, from 662 3/4 square inches on July 10.

Honey Production: The better two-pound package colony produced the greatest amount of honey (86 3/4 pounds); the better undivided, check colony (81 pounds), was higher than the better equal division (62 1/2 pounds) and three-pound package (77 1/4 pounds) colonies. The reduction of honey produced by the better undivided and equally divided colonies compared with other colony groups is correlated with the decrease in sealed brood area during the period of June 3 to June 28 (Plate III) because a period of 21 to 33 days is required for a bee in the sealed brood stage to become a field bee.

Effects of Loss of Queens

Division colony No. 21 lost its queen during the period

of June 16[2] and 24 and undivided colony No. 23 during June 4[2] and 10. Colony No. 21 raised a new queen and then continued as a normal colony. Colony No. 23 raised a new queen which was "balled" and thus killed. Following this queenlessness in colony No. 23 another queen from the same source as the original one was introduced by uniting a queen from a queen reservoir and was successfully accepted. The period, during which these two colonies were queenless plus the period of establishing the new queens, had great effect on their development as shown in Table 2 and Plate IV. The percentage of queen loss was 25 per cent. Such queen loss may result from ordinary supersedure or from excitement of bees when shaken from combs for counting the sealed brood or from both.

Honey Production: A period of 42 days is required for a fertilized egg from the time it is laid to become a worker field bee. The early nectarflow was during the period of May 30 to July 1 and the late nectarflow occurred from July 26 to August 31. According to this, losses of queens of the two colonies did not result in any loss of honey crop gathered by either of these two colonies during the early nectarflow, but it did result in loss of some of the honey crop gathered from the late nectarflow. This loss in honey crop was 1/2 pound (62 1/2 - 62) for the division colony No. 21 and 29 3/4 pounds (81-51 1/4) for the undivided colony No. 23 as shown in Tables

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2. The last time the queen was seen.

3 and 5. Therefore, the honey crop that was produced by colonies Nos. 21 and 23 from the late nectarflow, and consequently the total colony honey production (Table 2 and Plate IV), was not as great as it would have been if there had not been the interruption in brood rearing.

Honey production for all groups of colonies, including Nos. 21 and 23 that lost their queens, were closely correlated with their development. A large colony population means a greater possibility of good colony honey production as against a small colony population which means a small or no honey crop.

Total Honey Production

Comparison of total honey production (Table 4), shows that two-pound package colonies (304 pounds) were ahead of other group colonies. Undivided overwintered colonies produced 6 3/4 pounds less honey (297 1/4 pounds) than that of two-pound package colonies (304 pounds). If overwintered colonies developed normally without the sharp decrease in area of sealed brood that occurred during June 3 to 28, their honey production would be expected to exceed that of the two-pound package colonies. Nevertheless, according to these results, two-pound package colonies may be considered as better honey producers in areas of late nectarflow. This is in accordance of results obtained by many beekeepers in different localities. When beekeepers received packages early in the spring, and were properly managed and sufficiently fed with pollen and honey or sugar syrup, the packages produced as much or more honey than

overwintered colonies, especially in areas of late nectarflows, and also with less work required to overcome swarming. Three-pound package colonies (total of 258 1/2 pounds) were inferior to other group colonies. Since two-pound package colonies are cheaper in price and better honey producers than three-pound package colonies, the latter will be discarded from the comparisons given below:

a. Is it profitable to divide strong overwintered colonies in early spring? An overwintered colony produced 222 1/4 pounds of extracted honey while the total of the two divisions produced 436 1/2 (2 X 218 1/4 pounds) pounds (Table 4). This is a difference of 214 1/4 pounds of honey in favor of division as against price of one queen for a division colony. Therefore, it is clear that by equally dividing overwintered colonies early in the spring honey production is increased considerably to almost double that of the original colony if left undivided, without any cost except the price of a queen needed for one of the divisions.

b. Which is better practice, to make increase, buying packages or equally dividing strong overwintered colonies early in spring? From a review of the literature it was found that the cost of overwintering and cost of packages should be taken into consideration in the advisability of buying packages or overwintering. In this question, overwintering cost is not involved in the comparison. For instance a beekeeper owning 150 overwintered colonies in early spring wishes to make them 200, which practice will be better, buy 50 packages or divide

50 of his overwintered units? Of course, in both practices he has his 150 colonies overwintered. To simplify this example, it will be of the same result if it is said that a beekeeper owning one overwintered colony and he wishes to have two, should he divide his colony into two equal divisions or buy a package? If he divides one colony into two divisions they will produce 436 1/2 pounds of extracted honey (2 X 218 1/4); and if he buys a package (two-pound) in addition to the overwintered colony, their total production will be 451 1/4 pounds (222 1/4 produced by undivided colony plus 229 pounds produced by two-pound package) (Table 4). A difference of 14 3/4 pounds is in favor of buying a two-pound package, but cost of a two-pound package, without a queen should be deducted from the value of its honey production. Obviously, dividing strong overwintered colonies will be more profitable. The cost of package queen is not considered since all other colonies, in this example, overwintered, divisions and two-pound package are to be headed by a new queen. If these figures are analysed with the assumption that there is only one nectarflow, in this case the early nectarflow, only 2 1/4 more pounds of extracted honey was obtained in favor of buying a package against its cost without a queen (155 1/2 pounds produced by undivided; plus 148 3/4 pounds produced by two-pound package; minus twice 154 1/2 pounds produced by division). But if the late nectarflow is the main one, there will be 42 3/4 pounds as against the package price (81 undivided; plus 86 3/4 two-pound; minus twice 62 1/2 division). In this latter case, buying packages is the better practice than making divisions (Table 4).

c. Comparing the two beekeeping practices, i. e. overwintering versus killing colonies in the fall and reestablishing them in the spring on the basis that overwintered colonies would be divided equally early in the spring into two divisions and if cost of overwintering and cost of packages (two-pound) were estimated to be the same, then there would be a difference of 177 1/2 pounds (twice 218 1/4 pounds produced by the divisions; minus 259 pounds produced by the two-pound package) in favor of overwintering. But if this comparison is to be made on the basis that overwintered colonies would not be divided in the spring, then there would be a difference of 36 3/4 pounds of honey (259 pounds produced by the two-pound package, minus 222 1/4 pounds from undivided colony) in favor of killing colonies in the fall and buying packages in the spring (Table 4).

SUMMARY

The majority of beekeepers in the United States are primarily interested in honey production. They manage their colonies according to different beekeeping practices which vary in effectiveness depending upon the locality.

This study was conducted to compare different beekeeping methods in this locality as determined by honey production and colonies development. The groups of colonies used for this comparison were two-pound packages, three-pound packages, equal divisions, and undivided colonies. Two colonies were in each group.

Packages which were bought from the same source in the south

were hived on drawn combs of pollen and honey. Divisions were made by dividing adult bees, brood, honey and pollen of an overwintered colony into two equal divisions. Each division was hived on combs of pollen and honey. The undivided, overwintered colony, later divided, was before division, comparable in strength to the check, undivided colonies. Dadant hives were used. All colonies in the experiment were headed by new queens from the same source. Installation of package bees, divisions, and introduction of new queens to all colonies was done on April 1, 1954. All colonies were fed pollen and honey abundantly in addition to what the bees could gather from the fields. Colonies were protected by windbreaks in the spring and sunshades in the summer.

Area of worker sealed brood was measured regularly at 12-day intervals using a brood counter. The figures obtained were used for comparison of development of the various groups of colonies. There were two major nectarflows in 1954; the early one was from May 30 to July 1, and the late nectarflow was from July 26 to August 31. Amounts of honey in supers produced by each colony and from each nectarflow were used for comparison of honey production of various groups of colonies.

The conclusions drawn from this investigation are:

1. Undivided, overwintered colonies were better honey producers during the early nectarflow in this area; this is also probably true in other areas with similar weather conditions and nectar and pollen-producing plants, and which have their nectarflows beginning eight to nine weeks after establishment of package bee

colonies and divisions. Divisions were second best, two-pound package colonies ranked third, and three-pound package colonies ranked last.

2. Two-pound package colonies were the best honey producers during the late summer nectarflow as they had enough time to develop to their maximum strength. The other groups ranked in the following descending order of honey production: Overwintered, three-pound package, and division colonies.

3. Honey production of colonies was closely correlated with their population development; therefore supersedure, queen loss, or swarming would definitely result in reduction of honey production.

4. Extra work was required to overcome swarming in the overwintered colonies.

5. There was a loss of two out of eight queens used to requeen or head all colonies at the beginning of the experiment. This queen loss might be as a result of supersedure or excitement of bees from shaking or from both.

6. Package bees hived on full combs of pollen and honey develop into productive colonies in a relatively short time as compared to package bees not supplied with sufficient pollen and honey.

7. A period of nine to ten weeks was necessary for a package colony to reach its productive strength if hived on drawn combs of pollen and honey.

8. Two-pound package colonies developed better and produced more honey than three-pound package colonies during both

nectarflows.

9. Development of colonies was affected by performance of queens rather than by size of the worker force in colonies in early spring.

10. Dividing strong overwintered colonies equally early in the spring resulted in considerable increased honey production.

11. It was more profitable in honey production to divide strong overwintered colonies to make increase than buying package bees, except for areas of late major nectarflow in which buying two-pound packages was more profitable.

12. Overwintering of colonies was more profitable in honey production than killing bees in the fall and restocking hives with packages in the spring with the assumption that cost of overwintering and cost of package bees (two-pound) were estimated to be the same and on the basis that overwintered colonies would be divided equally early in the spring into two divisions. But if overwintered colonies would not be divided in early spring, then killing colonies in the fall and buying packages in the spring would be the better practice than overwintering of colonies.

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A COMPARISON OF EQUAL DIVISIONS, PACKAGE BEES, AND UNDIVIDED COLONIES AS DETERMINED BY HONEY PRODUCTION AND AMOUNT OF SEALED BROOD

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ABSTRACT

This study was conducted to compare various groups of colonies in their population development and their productivity of extracted honey for this locality. These groups of colonies were two-pound package, three-pound package, equal divisions and undivided colonies. These groups of colonies represent alone or in combination different common beekeeping practices.

Packages which were bought from the same source in the south were installed on combs of pollen and honey. Divisions were made by dividing adult bees, brood, honey and pollen of an overwintered colony into two equal divisions. All colonies of this experiment were headed by new queens that came with the packages. Installation of package bees, divisions and introducing new queens were done on April 1. These colonies were fed, sufficiently, with pollen and honey, and they were protected by windbreaks in the spring and sunshades in the summer.

Area of sealed brood was measured regularly at 12-day intervals. Honey in supers from each colony for each nectarflow was extracted and weighed separately. There were two nectarflows in 1954, the early one was from May 30 to July 1, and the late one was from July 26 to August 31.

Areas of sealed brood were used for comparison of the development of the groups of colonies; and amounts of extracted honey were used for comparison of honey production of the groups of colonies.

The conclusions drawn from this investigation are as follows:

1. Undivided, overwintered colonies were better honey producers during the early nectarflow in this area; this is also probably true in other areas with similar weather conditions and nectar and pollen producing plants, and which have their nectarflows beginning eight to nine weeks after establishment of package bee colonies and divisions. Divisions were second best, then two-pound package colonies ranked third and with three-pound package colonies ranked last.

2. Two-pound package colonies were the best honey producers during the late summer nectarflow as they had enough time to develop to their maximum strength. The other groups ranked in the following descending order of honey production: Overwintered, three-pound package and division colonies.

3. Honey production of colonies was closely correlated with their population development; therefore supersedure, queen loss, or swarming would definitely result in reduction of honey production.

4. Extra work was required to overcome swarming in the overwintered colonies.

5. There was a loss of two out of eight queens used to requeen or head all colonies of the beginning of the experiment. This might be as a result of supersedure or excitement of bees from shaking or from both.

6. Package bees hived on full combs of pollen and honey developed into productive colonies in a relatively short time as compared to package bees not supplied with sufficient pollen and honey.

7. A period of nine to ten weeks was necessary for a package colony to reach its productive strength if hived on drawn combs of pollen and honey.

8. Two-pound package colonies developed better and produced more honey than three-pound package colonies during both nectarflows.

9. Development of colonies was affected by performance of queens rather than by size of the worker force in colonies in early spring.

10. Dividing strong overwintered colonies equally early in the spring resulted in considerable increased honey production.

11. It was more profitable in honey production to divide strong overwintered colonies to make increase than buying package bees, except for areas of late major nectarflow in which buying two-pound packages was more profitable.

12. Overwintering of colonies was more profitable in honey production than killing bees in the fall and restocking hives with packages in the spring, with the assumption that cost of overwintering and cost of packages (two-pound) were estimated to be the same and on the basis that overwintered colonies would be divided equally early in the spring into two divisions. But if overwintered colonies would not be divided in early spring, then killing colonies in the fall and buying packages in the spring would be the better practice than overwintering of colonies.

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