PRODUCTIVE MANAGEMENT OF HONEY-BEE COLONIES

by Dr. C. L. FARRAR *)
U. S. A.

Summary

The basic requirement for productive colony management in beekeeping are large food reserves of pollen and honey at all times and ample room for these food reserves, brood rearing, and the storage of surplus honey. Young productive queens from good stock are essential. The queen should be supported by a large population favorable to the time of the year.

The object is to build maximum colony populations for the nectar flow and maintain them throughout the season. *The most populous colonies produce not only the most honey per colony but the most honey per bee.* Brood rearing is the basis of colony development and the maintenance of maximum populations during the flow. It is dependent upon: (1) the queen's capacity to lay eggs, (2) the supporting population's ability to maintain favorable temperature and feed the brood, (3) reserves of pollen and honey, and (4) space in the proper position for expansion of the brood nest.

Manipulations that maintain the most favorable organization of hive equipment for maximum brood rearing and honey storage will help to insure strong colonies and minimize swarming. The maintenance of a reserve of young productive queens in nuclei makes it possible to replace inferior queens promptly. The development of colonies inadequately provisioned with pollen can be increased by feeding pollen supplemented with 75 percent of soybean flour. Efficient management requires the proper timing of colony development so that maximum populations will coincide with the available nectar flows.

The beekeeper should be familiar with sources of pollen and nectar within his locality, their time of bloom, and relative importance. The selection of stock and equipment and the location and size of the apiary are individual problems subject only to the certain standards of principles discussed. An analysis of the economics of each beekeeping enterprise will prove helpful in developing efficiency in management. The most effective means of lowering the cost of honey production is to increase colony yields.

Introduction

Successful bee management entails the skillful application of knowledge and practices that will fully utilize the productive capacity of the honey-bee colony, with productivity favorably balanced against capital, operational, and labor costs. Because there are individual colonies in most apiaries that produce three to four times more honey than the

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average colony, the opportunities for improving colony management are at least threefold. Management costs for low-producing colonies usually equal and often exceed those for the best colonies because they require more labor to correct deficiencies that should be avoided. By raising the average yield to equal more closely that of the higher producing colonies, the beekeeper is also likely to improve productivity of his best colonies.

The honey-bee colony is highly adaptable to a wide range of climatic conditions and is usually productive wherever man successfully cultivates forage, fruit, and vegetable crops. There are many areas where the natural vegetation provides abundant pollen and nectar resources that equal or exceed those present in cultivated areas.

The object of colony management is to coordinate the colony's development with all the natural plant resources available in order to have the maximum number of foraging bees when the major nectar producing plants are in blossom. Every colony will have its own maximum population and production level, but efficient management requires that the beekeeper recognize the different levels of productivity in honey-bee stocks and keep only the best.

The principles of productive colony management are similar in all areas where bees are kept. Management problems in different regions vary only in the timing of colony development to coincide with the location's nectar and pollen resources as influenced by the climate and plant species available, including their abundance and period of bloom.

Honey bees are kept primarily for production of honey and wax, yet their role in pollinating seed and fruit crops contributes an economic return to agriculture many times greater than that derived from surplus honey and wax. Many thousands of colonies are kept or obtained through rental services for use in pollinating commercial seed and fruit crops. The need for pollinating bees has not yet been satisfied, and future requirements for this service can be expected to increase. Both pollination and honey production are dependent upon the number of bees that visit the flowers. Management, which increases the colony's honey storing efficiency, will also improve plant pollination.

The normal, unrestricted colony is capable of surviving and producing honey from the arctic to the tropics if there are sufficient blooming plants that produce pollen and nectar to provide food for the colony. Man is the honey bees' worst enemy. He tends to leave insufficient food for the colony's use during dearth periods and fails to provide ample hive space for the colony to develop and store honey, forcing it to swarm. A colony that swarms is substandard in strength during the production period, and it may even store insufficient food for its own survival.

The abundant pollen and nectar resources available in the most highly developed commercial beekeeping regions have been more or less responsible for extensive beekeeping operations involving "thousands of hives" with a minimum of thought as to what constitutes a full-strength colony of bees. *There may be as much difference between "hives of bees" and full-strength colonies as there is between a calf and a producing cow.* The rapid changes taking place in all agriculture may be expected to shift the emphasis from hives in great numbers in well-managed colonies. It is doubtful whether there is any beekeeping location where more than a small fraction of the available nectar is harvested by the bees. This may not be true of the pollen resources required for developing high-producing colonies. There are management procedures, however, for minimizing a pollen deficiency. Pollen gathering like nectar gathering is balanced by the supply of pollen produced by the flora and the number of bees to gather it. It is possible that colonies are unable to capitalize on many early pollen sources because their populations are too small when these plants blossom.

This provides information on principles and practices that will give the maximum return for each colony. The management practices discussed are directed towards the production of extracted honey in regions providing a dormant winter period due to low

temperatures. The principles on which these are based, however, apply equally to comb honey production and to other regions where there is an absence of pollen and nectar gathering due to normal plant growth cycles. Methods of handling the honey crop are not considered. No attempt is made to include all the well-known facts concerning bee life; neither are the advantages and disadvantages of the many specialized plans of management favored by individual beekeepers discussed. A vast beekeeping literature covers these subjects.

Fundamentals of Productive Beekeeping

An understanding of the fundamental relationships between colony populations and egg laying, brood rearing, and production, as well as the time factor in population growth, is nesessary to obtain maximum honey crops under any sistem of management. The cause-and-effect relationships are shown graphically in figures 1, 2, and 3 for colonies headed by prolific queens unrestricted because of insufficient pollen, honey, or hive space.

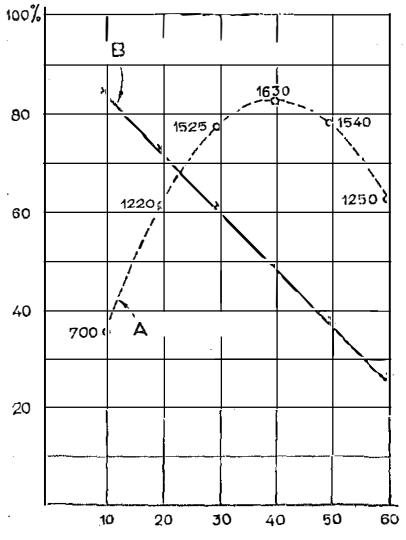

Fig. 1. — Influence of colony populations on daily egg-laying rate and brood rearing. (Cells of sealed brood divided by 12 equals average daily egg-laying rate; cells of sealed brood divided by the number of bees equals the relative brood production per bee.)
A. — daily egg laying; B. — ratio of sealed brood to bees.

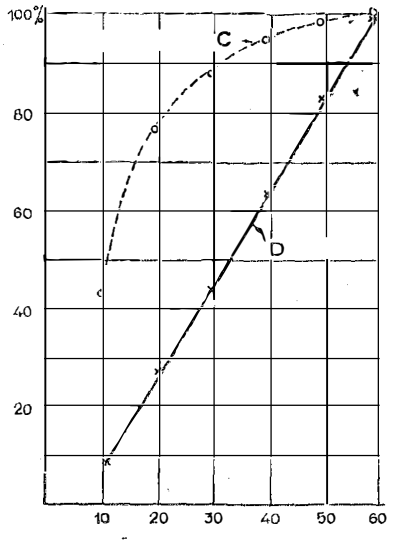

Fig. 2. — Influence of colony populations on colony yields and production per bee. (Colony gain at each population level divided by the yield at 60,000 equals the percentage yield; colony gain divided by its population equals the production factors per bee or relative production per unit number of bees.)
C. — relative production per bee; D. — colony production.

Colony populations are balanced by the colony's capacity for brood rearing, the time required to develop brood, and the length of life of adult bees. Good queens seldom lay more than 1,600 eggs per day. Twenty days are required for the brood to mature. Adult bees live from 4 to 6 weeks during the active season, and their longevity is influenced greatly by the intensity of brood rearing. Bees in small colonies that rear a proportionately large amount of brood have shorter lives than bees in more populous colonies. The

amount of brood reared is influenced by the queen's egg laying capacity, the colony's population, the supply of both pollen and honey, and the available comb space and its position.

The ratio between sealed brood and colony populations decreases 10 to 14 percent for each increase of 10,000 bees, whereas the average daily rate of egg laying by the queen increases with a rise in population up to 40,000 bees (fig. 1). A large colony produces more brood than a small colony yet has a higher proportion of its bees available for gathering pollen and nectar.

The production per unit number of bees in the colony is considerably greater in stronger colonies than in smaller colonies, since proportionately fewer bees are engaged in brood rearing. The relationships illustrated in figure 2 are expressed in percentages, since the available nectar will determine the actual colony gain.

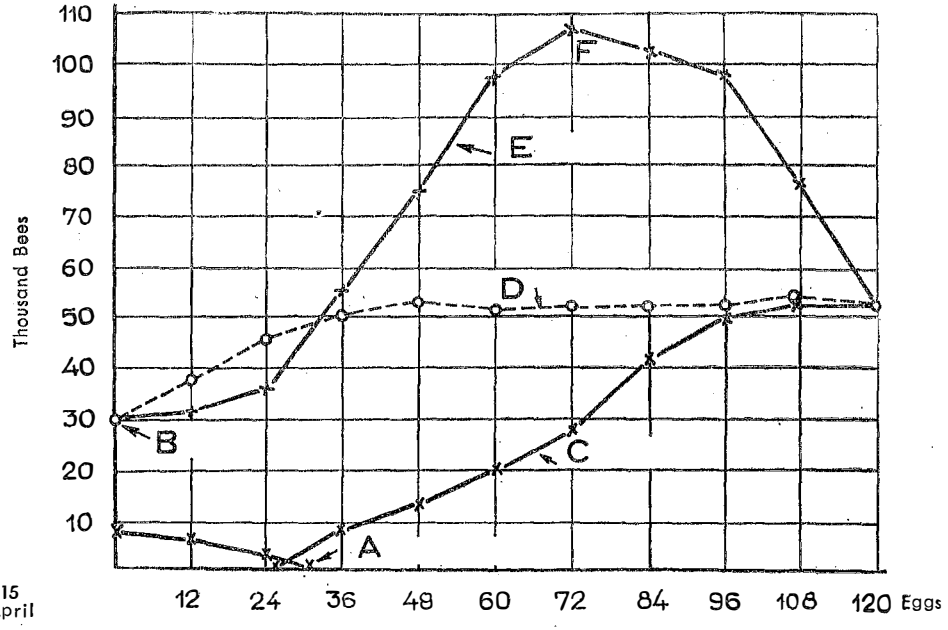

Fig. 3. — Time required for development of package, single-, and two-queen colonies.
A. — original package bees; B. — divided; C. — package colony; D. — single-queen colony; E. — 2-queen colony; F. — united.

During a 2 weeks' honeyflow, a fullstrength colony with 60,000 bees will normally produce 50 percent more honey than four small colonies each with 15,000 bees. Under a longer flow, the four small colonies will increase in population because of their higher relative brood production, thus narrowing the difference in yield between one strong colony and the four small colonies. There is no advantage, however, in keeping small colonies just because their storing efficiency increases; it is better management to have all colonies storing at maximum efficiency throughout the flow.

The time factors expressed in numbers of days required for the three classes of colonies to reach a maximum strength and enhance their maximum production efficiency are shown in figure 3. These colony growth curves are based upon daily egg-laying rates, time of brood development, and the length of life for adult bees when healthy colonies are headed by good queens and abundantly supplied with honey, pollen, and hive space in a favorable position. The production efficiency per unit number of bees in the two-

queen colony is equal to or slightly greater than that of full-strength single-queen colonies When a measurable nectar flow develops about the time the second queen is introduced the storing efficiency of the colony will be lowered, since more bees will be engaged in raising brood from the two queens. On the other hand, its production efficiency will be higher than that of single-queen colonies when united back to single-queen status. For 20 days such colonies have esentially double populations with brood from eggs laid by only one queen.

Good nectar flows are often not recognized because colony populations are too small to show gains. The producer of package bees can profitably manage colonies within the range of 10,000 to 20,000 bees, periodically shaking market bees. This is because colonies with 10,000 bees raise proportionately more brood than larger colonies. The beekeeper who keeps colonies for honey production or plant pollination must direct his management towards developing all colonies to full strength for particular crops. Package bees used to establish new colonies require 11 to 13 weeks to reach full production efficiency. The division of strong colonies 6 to 8 weeks in advance of the principal nectar flow to establish two-queen colonies is a means of obtaining relatively higher brood production early in the season and high production efficiency when nectar is available.

The object of management is to coordinate colony development to fully utilize the natural resources provided by the pollen and nectar producing plants in the area. The accepted commercial standard of 100 pounds of surplus honey per colony is not a desirable basis for judging the efficiency of any plan of management. Colonies that are at maximum producing strength throughout the flow may yield several times this amount. Only the best colonies should be used to judge the honey-producing resources of any season or locality.

The established beekeeper should prepare for a crop about a year in advance of the honeyflow. Reserve honey and pollen must be obtained to carry the colonies through dearth periods, including the winter when plant life is dormant. A colony to be overwintered in northern regions must rear sufficient brood to provide a cluster of 8 to 10 pounds of young bees that emerge between August 20 and the early part of October. In southern regions brood rearing may be extended 4 to 6 weeks later in the season.

The theory that reduced brood rearing or a queenless condition during a flow lasting 5 weeks will permit the colonies to produce a larger crop, because it takes 5 weeks to develop field bees after the eggs are laid, is not supported by actual returns. The superior working morale of normal colonies enables them to store more honey. Queenless colonies or those in which brood rearing is curtailed show a sharp drop in daily honey gains; also, the resulting decline in their populations may further reduce production from later flows or prevent the colonies overwintering properly.