

From Hive to Harvest: The Art and Science of Beekeeping

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SUMMARY

Beekeeping is a simple, low-investment and economically rewarding agricultural enterprise that can be adopted by farmers and other individuals irrespective of landholding or age. A healthy bee colony consists of a queen, a large number of worker bees and drone bees, which work together in a well-organized social system. Successful beekeeping requires appropriate equipment, healthy bee colonies and proper seasonal management. The beekeeping year can broadly be divided into the food-scarcity period, colony development period and honey-flow period. During periods of food scarcity, supplementary feeding with sugar syrup and other suitable feeds is essential to prevent colony weakening or migration. During favourable periods, colonies can be multiplied, strengthened and managed for efficient honey production. Adequate protection from excessive rain, heat and water scarcity, replacement of old queens and timely harvesting of honey are also important management practices. In addition to providing honey and other valuable products, honey bees play a significant role in pollination and contribute to increased agricultural and horticultural productivity.

INTRODUCTION

Beekeeping is an important and sustainable agricultural enterprise that provides an opportunity for farmers, rural youth and women to generate additional income with relatively low investment. Honey bees are highly organized social insects that live in colonies consisting of a queen, worker bees and drone bees, each performing specific roles essential for the survival and growth of the colony (Crane, 1990). Apart from producing valuable products such as honey, beeswax and other bee-derived products, honey bees play a vital role in the pollination of agricultural and horticultural crops, thereby contributing to improved crop yield and quality (Kevan and Phillips, 2001). Successful beekeeping depends on proper colony management, availability of nectar and pollen sources, supplementary feeding during periods of food scarcity, protection from adverse weather conditions and timely harvesting of honey. With appropriate scientific knowledge and seasonal management practices, beekeeping can serve as a profitable supplementary enterprise while also supporting biodiversity, sustainable agriculture and enhanced crop productivity.

Bee Colony

A well-organized bee colony consists of a single queen bee and approximately 5,000 to more than 50,000 worker bees. Generally, hundreds of drone bees are produced, particularly during periods of queen rearing and when pollen and nectar are abundantly available (Klein *et al.*, 2007).



Equipment Required for Beekeeping

The important equipment required for beekeeping includes:

- Bee hive, Bee colony, Bee veil or face protection, Gloves, Smoker, Queen Excluder, Hive cleaning tool and Honey extractor.

Methods of Obtaining Bee Colonies

Bee colonies can be obtained through the following methods (Winston, 1987):

- Identifying the natural habitats of the Indian honey bee and transferring the colonies into bee boxes.
- Purchasing bee colonies from other beekeepers.
- Collecting naturally swarming colonies. When a bee colony divides naturally, the swarming bees temporarily settle on the branch of a tree. Such colonies can be easily collected and transferred into a bee box.

Management of Bee Colonies during Different Seasons

Different changes occur in the lifestyle and activities of honey bees throughout the year (Potts *et al.*, 2010). Based on these changes, the beekeeping year can broadly be divided into three important periods (Sihag, 1993):

1. Dearth or Food Scarcity Period
2. Colony Development and Multiplication Period
3. Honey Flow or Honey Harvesting Period

1. Dearth or Food Scarcity Period (June-September)

The four months of the rainy season are generally considered as a period of food scarcity for honey bees. During this period, bees should be provided with artificial feeding by preparing a 1:1 mixture of sugar and water. The mixture should be boiled, cooled and then supplied to the bee colonies (Morse and Calderone, 2000).

Whenever a shortage of food occurs during any season, supplementary feeding should be provided to protect and maintain the bee colonies.

Table 1. Nectar and pollen substitutes and their impact on honey bee (Kavimugilan *et al.*, 2024)

Nectar and Pollen substitutes	Effects
Skimmed milk powder + Kryeast	More production of honey, no effect on brood growth
Soybean nuggets + Peanut cake	Inadequate brood rearing and consumption
Lactalbumin + torula yeast	Inadequate brood rearing
Torula yeast + Soybean flour	adequate brood rearing
Torula Yeast	Adequate brood rearing
Lactalbumin + Torula yeast	Adequate brood rearing
Brewer's Yeast + Parched gram + Skimmed milk powder + Sugar	Adequate brood rearing
Skimmed milk + Black gram	Increased honey production number of frames
Casein + Sucrose + cholesterol + Alphecel + Salt mixture + Tocopherol + Vitamin	Positive results on hive development
Vitamin B-complex + Maize flour + Methionine	Increased bee frames, brood area and honey stores
Feed bee	Increased brood progression, honey stores and bee strength
MegaBee	Hypopharyngeal gland progression
Soy flour + Brewer's yeast + Soy protein	More bee strength, Adequate brood rearing
Germinated pea powder + Brewer's yeast + Skimmed milk powder + Honey	Improved brood area, honey stores and pollen stores
Brewer's yeast + powdered sugar + bee honey + turmeric + vitamins + mint oil + fenugreek powder + orange + juice sugar	Honey production, Adequate consumption

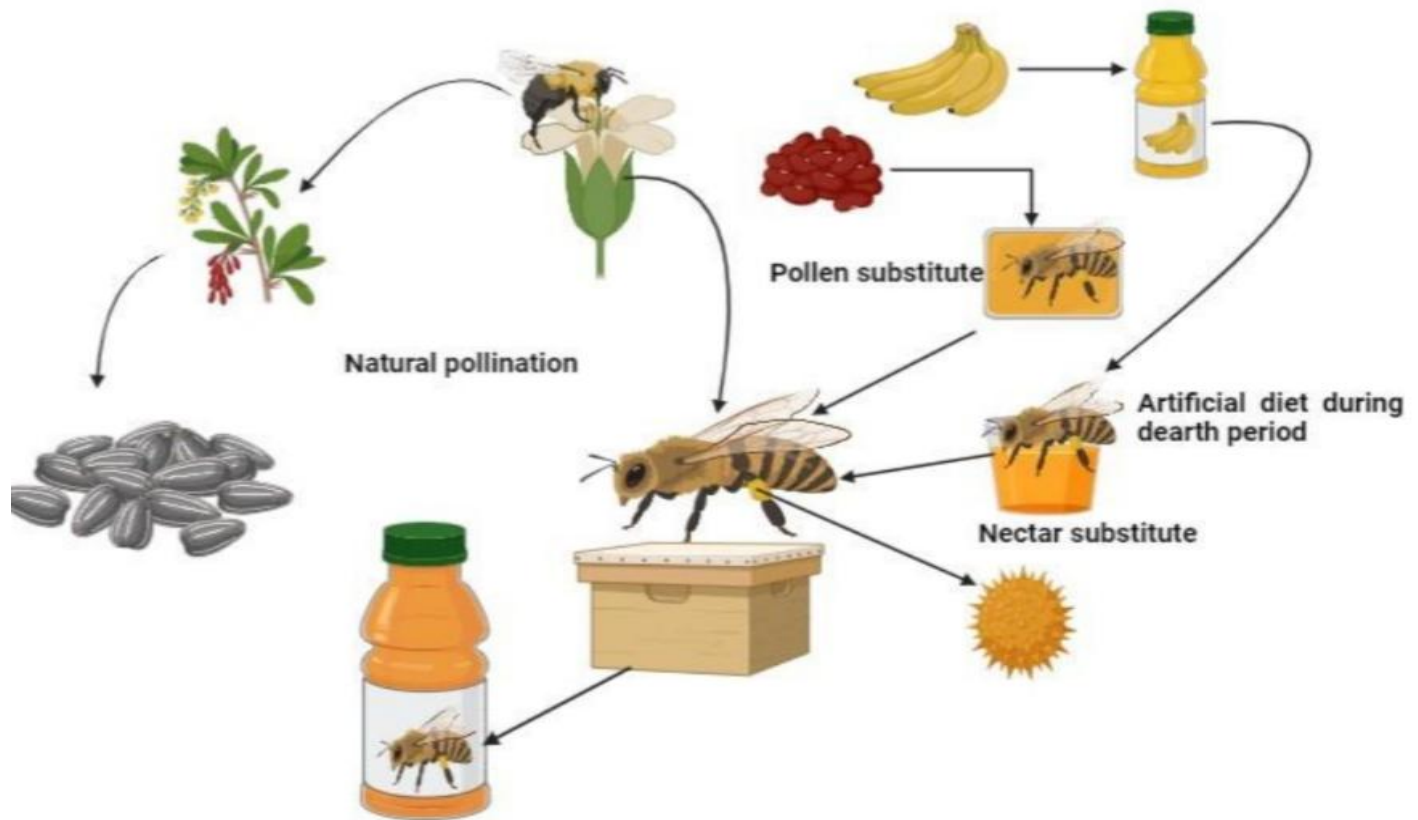


Fig.1. Bee feeding with artificial diet at dearth period (Kavimugilan *et al.*, 2024)

2. Colony Development Period (October-December)

After the rainy season, sufficient food becomes available to honey bees and they concentrate more on colony development and multiplication. Depending on the number of brood cells, queen cells are constructed. Subsequently, the queen bee may leave the original colony along with a group of worker bees to establish a new colony.

Therefore, this period is considered suitable for colony multiplication and increasing the number of bee colonies (Ogilvie and Caradonna, 2022).

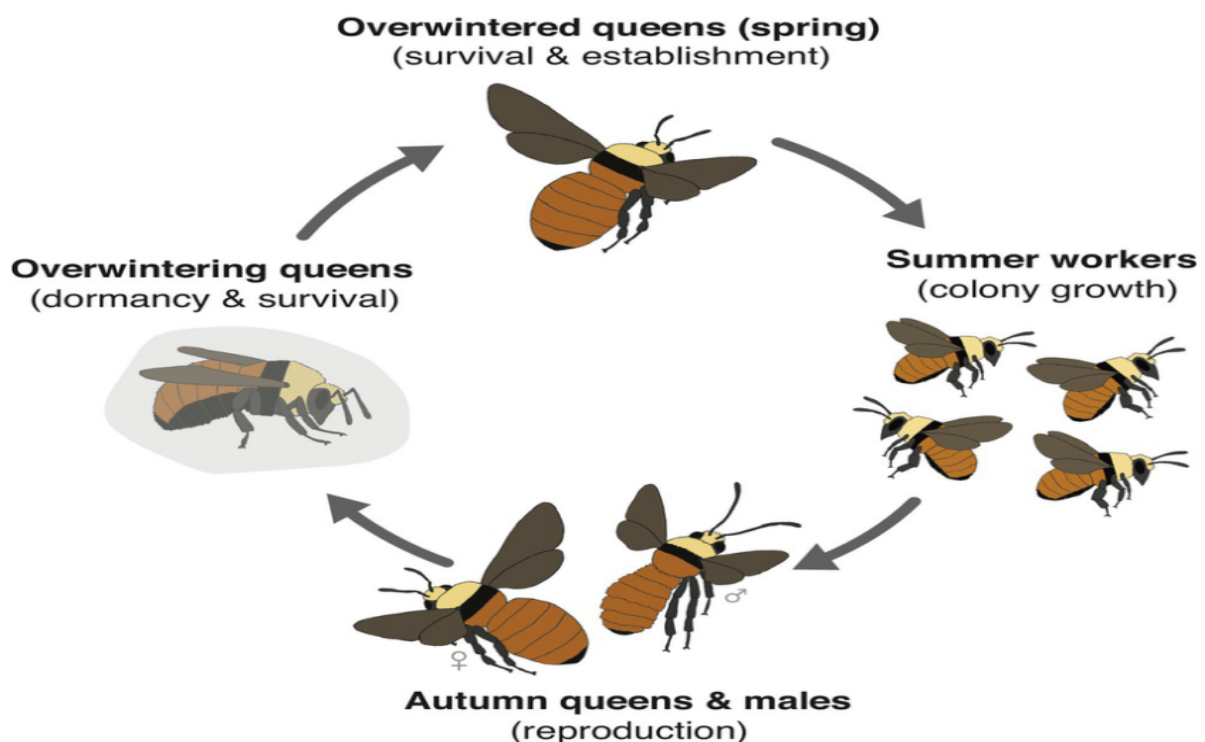


Fig.2. Annual life cycle stages of a bee colony

3. Honey Flow or Honey Harvesting Period (December–May)

During this period, nectar and pollen are abundantly available. Honey bees actively collect nectar and pollen from flowers and convert the nectar into honey. The honey stored by the bees can be extracted using a honey extraction machine.



Fig.3. Harvesting period

Management of Bee Colonies

- Many plant species in the environment produce pollen and nectar throughout the year, whereas some plants produce them only for a few days or months. As a result, honey bees may experience food shortages during certain periods depending on the region.
- With the beginning of January, honey bees become more active. This is a suitable time for beekeepers to establish bee colonies in their empty hive boxes.
- During February, food scarcity may occur in certain areas. Therefore, supplementary artificial feeding should be provided whenever necessary.
- In March, some bee colonies may prepare queen cells and show a tendency to swarm. Such colonies can be divided and multiplied appropriately.
- During April, many trees, shrubs and climbers come into flowering. Honey bees actively collect large quantities of pollen and nectar and store more honey during this period.
- During the subsequent rainy months, special attention should be given to maintaining the appropriate temperature inside the bee colony. The colony should have sufficient bee strength and if necessary, suitable insulating or covering materials should be provided to protect the hive.
- During periods of food scarcity, honey bees may abandon the hive. Therefore, artificial food in the form of sugar syrup and supplementary pollen feed should be provided to maintain the colonies.
- Some colonies may produce an excessive number of drone bees. In such cases, it is advisable to replace old queens with young and productive queen bees.
- During favourable periods, colonies develop well and store sufficient quantities of honey. The stored honey can then be harvested.
- During the summer season, when water availability is limited, a clean source of water should be provided near the bee hives.

Table 2. Bee Pasturage in Horticultural crops (Kavimugilan *et al.*, 2024)

Crop	Bee species	Effect on yield
Avocado	<i>A. mellifera</i>	High fruit set, production and fruit weight
Citrus	<i>A. mellifera</i>	Large fruit with low acid content
Cocoa	<i>A. mellifera</i>	Contribute to cross pollination, enhances pod development and yield
Coconut	<i>A. mellifera</i>	Fruit set was increased
Coffee	<i>A. mellifera</i>	Increased fruit set, yield increased by 25 %, uniform ripening
Coriander	<i>A. cerana indica</i>	69.51 % of seed set and yield enhanced by 14.57 q/ha
Cucumber	<i>A. mellifera</i>	Increased yield by 10 %
Guava	<i>A. mellifera</i>	Increased fruit set and improved fruit quality
Mango	<i>A. cerana indica</i>	Efficient pollination, 42.29 % of fruit set, enhanced yield by 30-40 %
Passion Fru	<i>A. mellifera</i>	Lead to successful pollination, higher yield and better- fruit quality
Papaya	<i>A. mellifera</i>	Enhanced pollination, fruit set, yield and quality

CONCLUSION

Beekeeping has great potential as a sustainable and profitable subsidiary enterprise in modern agriculture. Its relatively low requirement for land, capital and labour makes it particularly suitable for small and marginal farmers, women and rural youth. Proper management of bee colonies according to seasonal changes is essential for maintaining strong and productive colonies and obtaining higher honey yields. Providing supplementary food during dearth periods, ensuring adequate water availability, protecting colonies from unfavourable weather conditions, timely colony multiplication and proper harvesting practices can significantly improve the success of beekeeping. More importantly, the role of honey bees extends beyond honey production, as their pollination services contribute substantially to improved fruit set, yield and quality of many agricultural and horticultural crops. Therefore, promoting scientific beekeeping can strengthen rural livelihoods, support sustainable agriculture, conserve pollinators and contribute to overall agricultural productivity.

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