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USE OF UNCONVENTIONAL TIMBERS FOR BEEHIVES

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ABSTRACT

This study was carried out to evaluate the suitability of different types of locally available timbers as beehives under field conditions so as to replace the costly teak wood normally used for the purpose. The timbers for making beehives included jack, eucalypt, coconut wood, silver oak and treated rubber wood in addition to teak. The performance of the beehives in the field was evaluated with the help of professional bee keepers. With regard to the workability and durability, all the timbers tested were good and compared well with teak wood. All the bee boxes made of various timbers were free from growth of algae, fungi etc. The bee boxes made of treated rubber wood were acceptable to the bees and the honey yielded from such hives was normal in its composition and compared well with that from untreated beehives. Information available on the use of non-wood materials to rear honeybees was collected but experimentations were not conducted on this aspect. During the study period, foraging and colony growth were normal in all the boxes tested, but in a few colonies the bees left the hives during 1994-'95 and 1996, mainly due to the Thai Sac Brood Virus disease.

1. INTRODUCTION

Modern bee keeping in India has its origin during the beginning of twentieth century. Bee keeping is administered under the Village Industries Department and is being managed through the State Khadi and Village Industries Boards. Other departments such as Agriculture and Horticulture also deal with bee keeping independently.

The services rendered by productive and useful insects such as honeybees are indispensable to mankind and help in several ways for human welfare. In addition to providing the useful products such as honey and wax, honeybees also serve as efficient pollinating agents. Thus bee keeping helps in the production of food and is of immense importance in agriculture, horticulture and forestry. Its value in terms of crop production is well known and cannot be described in terms of monetary gains.

There are four species of honeybees prevalent in Kerala. *Apis cerana indica* F. occur naturally in hollow trunks of trees and or in rock-holes etc. This species is domesticated and can live as colonies in beehives for longer periods. *Apis dorsata* makes nests in the branches of tall trees or inaccessible parts of rocks. This bee is responsible for bulk of the honey production from forests. It is a bit agitative in behaviour, but yields higher quantities of honey. This species has the tendency to leave the nest after the honey production period from year to year. *Apis florea* builds its colony in the branches of shrubs under shade and also shifts the nests often. *Trigonia* sp. is the smallest among the honeybees which makes colonies in crevices of the basements of buildings, walls etc. It lives for a maximum of 20 days and the yield of honey will be less, but of high medicinal value.

Bee keeping industry in Kerala is concentrated mainly in and around rubber plantations and bulk of the honey extracted is from rubber trees. (Nehru *et. al*., 1984) Bees require both pollen and nectar, but rubber trees provide only nectar, and pollen is usually obtained from other natural vegetation. It is generally observed that if pollen sources are limited, the strength of colony goes down which in turn will affect the honey yield.

Kerala is in the forefront of bee keeping for honey production in the country. Over 5,800 tonnes of honey are produced annually from the bee hives as per data available for the year 1993. This is exclusive of the honey produced in forests by the wild bees.

One major constraint which affects bees and honey production is non-availability of bees throughout the year in a specific locality. Thus the only option available is to domesticate the bees in beehives. The Khadi and Village Industries Commission (KVIC) coordinates the activities of all bee keepers in the country and a rough estimate in 1991 indicates that the annual production of honey from nearly 7,00,000 bee colonies was about 10, 000 tonnes.. Many rural people depend on bee keeping for their livelihood. Also bee keeping offers prospects to unemployed youth and rural women. Due to the dwindling of timber resources and supply and due to the escalation of prices, several species other than teak have been recommended by the Bureau of Indian standards for manufacture of bee boxes. However, except for the local efforts made by some of the bee keeping societies, no concerted efforts were made in testing their suitability and acceptability. In the absence of proper wooden bee boxes, many bee keepers in Kerala make use of packing cases, clay pots, aluminium sheets etc., to keep the bees during honey seasons. Thus there is a need to find out suitable alternatives or timbers which are cheap and locally available for making the beehives.

Hence, the main objective of the study was to evaluate the suitability of different types of locally available and cheap timbers including treated rubber wood for making bee boxes and to test them under field conditions so as to replace the costly teak wood boxes. As bee keeping is an art to be mastered through practical experience, the field evaluation was carried out with the help of local farmers having exposure in bee keeping.

2. MATERIALS AND METHODS

Beehives made of the following timbers were evaluated under field conditions -

- Coconut wood
- Eucalypt wood
- Jack wood
- Treated rubber wood
- Silver oak wood
- Teak wood

The criteria adopted for selection of the species of timber were availability and abundance in the local area. Teak wood was included as a standard for comparison. Five bee boxes each were made from all the above mentioned timbers. The standard measurements of the beehives were adhered to and the work was entrusted to a bee keeper with knowledge of carpentry. Since the boxes were made with precision and also in smaller numbers, an economic evaluation as done in large-scale production was not possible. However, information on the cost of timber required to make the beehives was available, from which the comparison could be made. All the boxes were placed on raised platforms and coated with green paint outside. Care was taken not to coat the paint either on the frames or inside the bee box.

While making the boxes, workability of the different timbers was subjectively assessed by the carpenter.

The field performance of the bee boxes was evaluated with the help of professional bee keepers, initially for two seasons at Peechi and for one season at Kuzhalmandam near Palghat, using colonies of *Apis cerana indica* which were collected through different sources and established in hives made of different types of timbers. All the boxes were kept at random in the farmer's field as shown in Figure 1.

During the 3 - year period of observation, the beehives were exposed to natural outdoor conditions, except that during rainy season, the boxes were covered with plastic sheets.

Attempts were made to establish the bee colonies in the hives from 1995 onwards and the problems encountered were noted. Possible deformities of the timber with which the beehives were made such as warping, cracks etc., and also the growth of fungi or algae on the wood surface of the beehive etc., were observed.

The honey sample obtained form the treated rubber wood beehives was analyzed in the microbiology department of the Central Tuber Crops Research Institute (CTCRI) at Trivandrum to see whether the honey obtained from the hive made out of treated rubber wood had the same properties as obtained from normal untreated beehives.

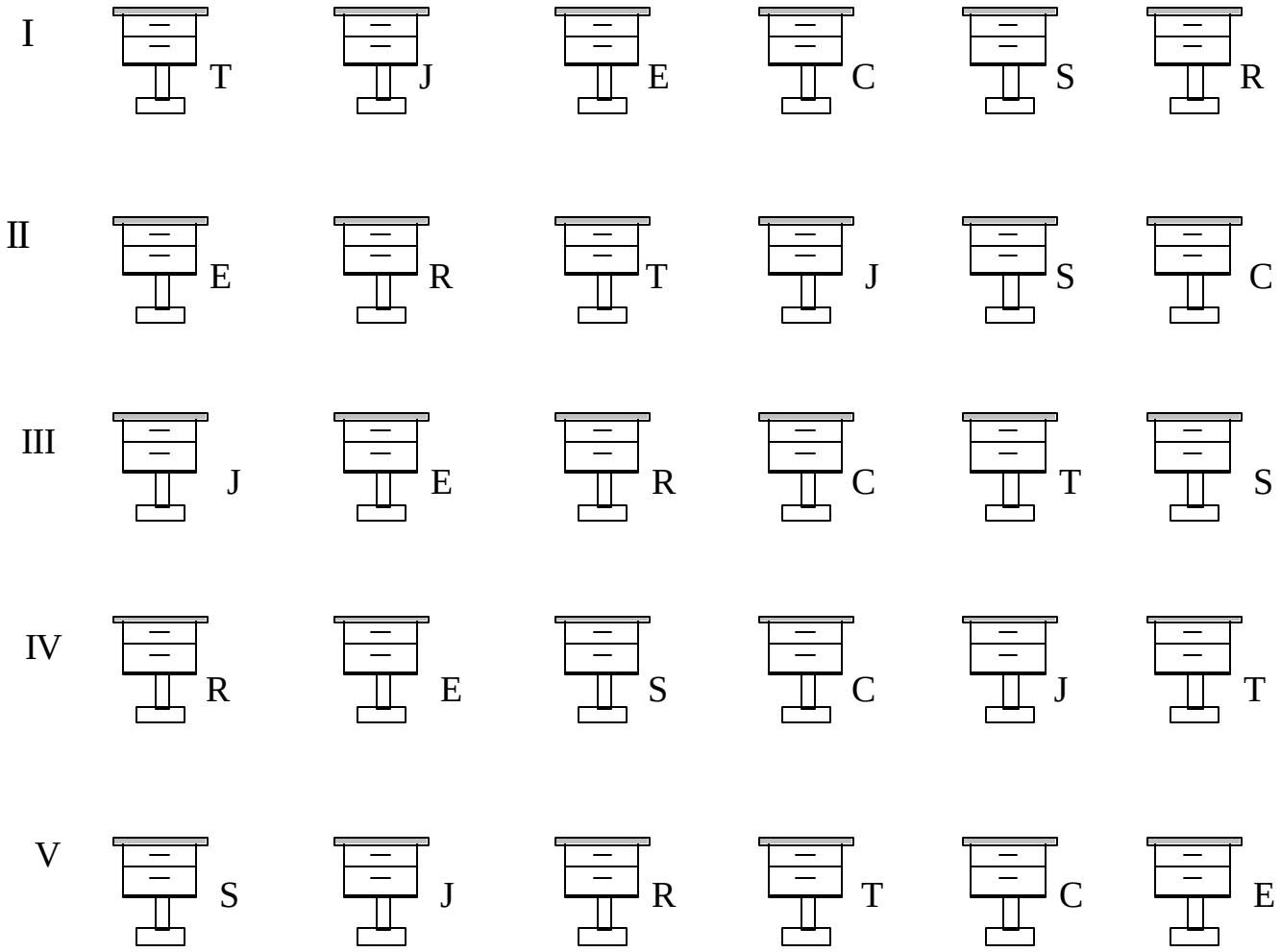


Fig.1. A pictorial representation of the lay-out of the apiary in the field

T.Teak wood J. Jack wood S. Silver oak wood

E. Eucalypt wood C. Coconut wood R. Treated Rubber wood

3. RESULTS AND DISCUSSION

3.1. General properties of the timbers tested

The information gathered from the carpenter while making the bee hives using different species of timber and some of the other qualities are given in Table 1.

Table 1. Information on some of the qualities of timbers tested

Timber	Local availability	Cost	Attractiveness to bees	Cleanability for reuse
Teak	Common	High	Good	OK
Eucalypt	Common	Low	Good	OK
Jack	Common	Low	Good	OK
Coconut	Common	Low	Good	OK
Silver oak	Not very Common	Low	Good	OK
Treated rubber wood	Common	Low	Good	OK

3.2. Service conditions of the beehives

All the boxes were exposed to natural conditions from 1994 to 1997. In 1995 and 1996, the beehives were maintained at a farmer's land in Peechi and during 1997, because of the increasing problem of bees absconding from the hives, the hives were taken to Kuzhalmandam near Palghat. There also the hives were maintained in the field and exposed to nature, except that during the rains they were covered with polythene sheets. All these years, none of the beehives showed any growth of fungi, algae etc. inside the hives. Also warping, cracks etc., which can happen in the case of some timbers, were not observed in any one of the beehives tested, during the observation period.

In order to establish the bee colonies in the experimental beehives, colonies of *Apis cerana indica* were either collected from natural sites or purchased from professional bee keepers. Initially, establishment of bee colonies in the experimental beehives was only partly successful and the problems encountered are briefly mentioned. However, the beehives in

which colonies were established included all the six timbers tested, indicating their acceptance by *A. cerana indica*.

3. 3. Thai Sac Brood Virus (TSBV) Disease

This virus disease affects the larvae and results in their death before pupation. The dead larvae were seen stretched in the bells of brood comb. It was observed that the worker bees usually removed the dead larvae from the beehives. However, when the number of dead or diseased larvae was more, worker bees did not care to remove the dead ones. The dead larvae which remained in the cell developed a brown colour with a black spot on the tip, which is characteristic of this virus disease. When the number of dead larvae was on the increase, it resulted in a foul smell within the brood chamber and the bees gradually deserted the hive. During 1995 and 1996, only 12 colonies of *A. cerana indica* could be established and all the colonies had TSBV disease problem at some stage or other. A short account on the TSBV disease and its present status in Kerala are provided in **Appendix 1.**

3. 4. Absconding behaviour

It was also observed that at least in eight beehives there was a tendency for the bees to abscond. Usually the absconding of bees occurred during food scarcity. It is possible that the TSBV disease can also result in absconding of the bees. Reddy and Kantharaj (1994) noticed high incidence of absconding in *A. cerna* colonies wherein more than 10% of the larval mortality occurred due to TSBV disease. Also, it is known that high humidity and temperature within the hives can cause irritation which will result in absconding behaviour. The exact reason for the above phenomenon in the present study could not be understood.

Other than these, ants and in one or two cases, lizards were found to disturb the colonies which may also irritate the bees and can result in leaving the hives.

3. 5. Foraging activity

Colonies of *A. cerana indica* could not be successfully established in all the beehives due to reasons mentioned under paras 3.3 and 3.4. Therefore, observations on foraging activity of the bees were restricted to only two colonies – one maintained in the treated rubber wood beehive and another on teak wood beehive. Observations showed that peak hours of foraging activity were from 0600 to 0800 hours. The number of foragers or

nectar gatherers entering the hive within the above said period was maximum compared to other periods. Evening from 1600 to 1800 hours was also an active period for foraging, but only less number was observed compared to the morning hours. No quantitative information on the foraging activities was collected. While taking observations on the foraging activities, it was also possible to get some information on the vegetational complex around the area, which the bees visited. The details of vegetation in and around the area where the beehives were maintained and bees visited during the foraging activity are given in Table 2.

Table. 2. Important sources of pollen and nectar for the bees in the study area

Plant species	Flowering period
Acacia sp.	January – March
Amaranthus sp.	June – December
Anacardium occidentale	November – April
Azadirachta indica	February – September
Cassia fistula	February – April
Cocos nucifera	Throughout the year
Delonix regia	February – July
Hevea braziliensis	February – June
Ixora parviflora	January – March
Mangifera indica	December – May
Manihot esculenta	December – March
Tamarindus indica	September – April
Tectona grandis	May – October
Hibicus rosasinensis	Throughout the year

The major nectar source was a rubber plantation close to the farmer's land. The major source of pollen was found to be the coconut palms which were available in plenty in the locality. It is known that honey bees are attracted to the flowers of coconut for both pollen and nectar. Another advantage for visiting the coconut palm is that it remains in bloom almost thoughout the year and the bees were found to visit both tall and dwarf varieties of coconut palms.

3.6. Acceptance of the treated rubber wood beehives and chemical characteristics of the honey obtained from the same

The rubber wood treated with boric acid - borax was used for making the beehives. Treated wood, in general, is not recommended for making beehives, because it is possible that such hives may not be acceptable to the bees and/or the honey obtained from such hives can be contaminated. Therefore the acceptance of the treated rubber wood beehives as well as the chemical analysis of the honey obtained from these hives were investigated.

The analyses of only important ingredients or properties of honey obtained from treated rubber wood were carried out (AOAC, 1983) and the results are summarized in Table 3.

Table. 3. Properties of the honey obtained from treated rubber wood beehives

Sl.No.	Properties	Average values	Average values of normal honey (Nehru and Jayarathnam 1995)
1.	Moisture (%) (Water content)	20	22
2.	Specific gravity	1.04	1.37
3.	Ash(%)	0.2	0.216
4.	Protein(%)	0.6	0.138
5.	Non-reducing sugar Sucrose (%)	1.5	1.71
6.	Reducing sugars Levulose (%) Dextrose (%) Maltose (%)	 36.5 32.0 9.0	 37.1 35.9 -

The beehives made of treated rubber wood were accepted by the bees and the colony established well in such hives. The colony growth, i.e. of the brood as well as bees was normal and comparable with other established colonies. The foraging activity as well as the storage of pollen and nectar in the beehives of both treated rubber wood and teak wood were comparable.

The results of the chemical analysis of the honey sample obtained from treated rubber wood beehives show that it is very well comparable with the normal honey obtained from untreated boxes. The average values compared in the table are of honey samples obtained from beehives kept in rubber plantations (Nehru and Jayarathnam 1995). Beehives made with treated preservative chemicals such as chromated copper arsenate (CCA) and copper naphthenate were field tested by Weatherhead (1984) and honey obtained from such hives contained 0.43 ppm of copper, well within the permissible limit of 10 ppm. However, he warned against the use of insecticidal formulations, especially the organochlorines along with the preservatives. In yet another study, beehives made of compressed fibreboard material were not acceptable to the bees and mortality of workers in the colony was observed mainly due to excess formaldehyde present in the fibreboard (Jaycox, 1979).

During routine rearing of insects in the entomology laboratory of the Institute, the adult moths of *Hyblaea puera* (teak defoliator) were fed with the honey obtained from beehives made of treated rubber wood and found to be quite safe. The adults mated, the females laid eggs and the overall survival of various stages of the insects were found to be quite normal.

3. 7. Non-wood materials to rear honey bees

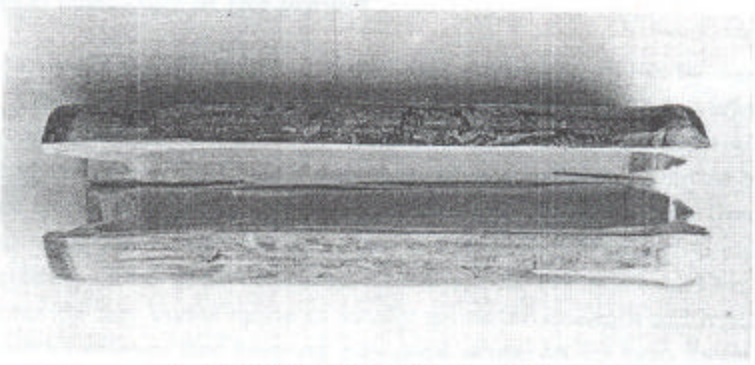
3.7.1. Earthen pots

In many parts of Palghat District, bees are reared in earthen pots. The mouth of the pot is fixed to the branch of a tree, at least 2-3 metres above the ground. This has been mostly observed on *Tamarindus* trees. Even without domestication, sometimes the bee colonies settle and survive in the earthen pots. During the present field trials at Kuzhalmandam near Palghat, one of the bee colonies maintained in the wooden beehives deserted and settled in an empty earthen pot already kept in a nearby Tamarind tree. From the local people it was learnt that rearing bees on earthen pots was successful, but invariably resulted in the destruction of the pot. The scope of earthen pots on a large-scale needs further evaluation.

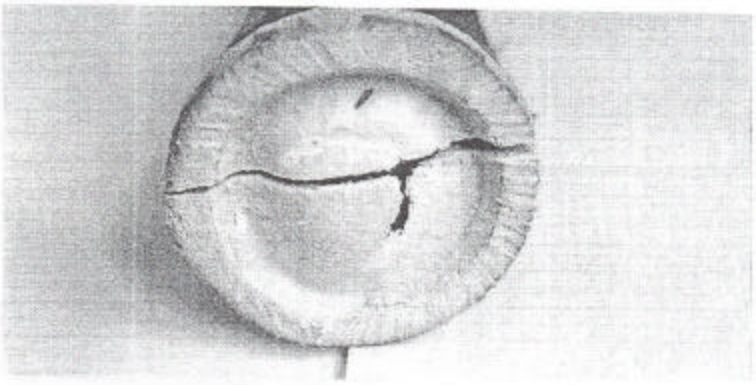
3.7.2.Bamboos

Dry bamboo culms, split in the middle and with a hole on the side (Figs. 2a,b) was tested to rear the Damer bees (*Trigonia* sp). They usually nest in small crevices of the buildings, compound walls etc. Fixing the bamboo

culms close the holes near the walls was difficult, but on many occasions, the bees got established in the bamboo culms.



2a. Bamboo culms split in the midle



2b. Same as 2a showing the entry hole for the bees

3.7.3. Synthetic combs

Plastic combs made of high density polyethylene have been reported to rear *A. cerana indica* and found that honey was stored in both super and brood frames (Soundar Rajan and Kumar, 1994). The advantage of these combs is that it can be washed and sterilized in hot water up to 55^0 C and thus can prevent TSBV disease to a great extent. Though there are several advantages for this, unless it is mass produced by some entrepreneurs, plastic combs cannot be popularized. It is stated that such combs are in use in the U.S.A. In India recently, the plastic frames are being supplied by a commercial firm Dabur Ltd. In India. This company also manufacture

hives made of thermocole, the suitability of which requires further field testing. In the present study it was not possible to evaluate the scope of plastic combs.

3. 8. Social relevance of the project

Bee boxes made of teak wood is costly and is not affordable by many bee keepers. Treated rubber wood, jack wood, eucalypt wood etc., which are locally available were found to be good and as a substitute for teak wood for making beehives. This work was carried out with the help of farmers interested in bee keeping in the farmer's land locally and hence they could get a first hand knowledge on the scope of using unconventional timbers to make beehives. The socio-economic relevance of the work is that it will help to provide bee boxes made of locally available cheap wood material to the interested public. Bee keeping has good scope as an agro/forest based industry, especially to help the weaker sections of the society with a dignified self-employment opportunity.

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Appendix 1

TSBV disease and its present status in Kerala

This dreaded disease (TSBV) spread in Kerala during 1991-'92 and thousands of colonies were lost and there was a time when it was thought that all the bee colonies of *A.cerana indica* were wiped out. This virus is reported to be very close to the Sac Brood Virus (SBV) which infects the European honey bee *Apis mellifera,* but distinct from it (Bailey et al, 1982). Thai Sac Broad disease was reported first in Thailand in 1976. Low temperature plays an important role in the intensity of this disease and the disease is reported to spread fast when the brood rearing is at its peak (Verma and Joshi, 1985).

Four-day-old honey bee larvae are more susceptible to TSBV. In the case of severe infections mass absconding of bee colonies is observed, sometimes leaving the queen behind (Suchwant Singh and Koul, 1985). Abrol and Bhat (1990) reported that in nature TSBV multiplies in adult bees without causing obvious disease. The young workers are more susceptible and become infected when they remove the larvae died due to TSBV disease. Infected nurse bees probably can transmit the disease when they feed the larvae with secretions from the glands. In big apiaries, the disturbance and drifting of bees due to TSBV can help the spread of the disease to healthy bee colonies. It is reported that the disease has disappeared after a period of four years in most places in northern India as well as in Thailand (Shah and Shah, 1988). It is also recorded that a small percentage of *A. cerana* survive in some areas even after severe outbreak of the disease (Verma and Joshi, 1985) and probably this could be due to the immunity developed by such colonies. Shah and Shah (1988) have reported that in Thailand, Nepal and in a few states of India like Uttar Pradesh and Nagaland, the TSBV has declined or disappeared after 4 years of its first occurrence.

Present status of TSBV in Kerala

In Kerala, the dreaded situation encountered during 1991-'92 has changed, recently. In general, there is no effective treatment against this disease, but proper maintenance of the bee colonies in hygienic conditions would help controlling the TSBV disease. Nehru *et.al* (1994) reported that over 76% colonies of *A. cerana indica* were lost due to TSBV disease in Kerala. Kozhicode, Thiruvananthapuram and Kottayam districts accounted for 95%, 94% and 93% loss of bee colonies respectively. It is understood that a few

colonies have escaped the disease and survived later on and nearly 50% of the lost population is regained by 1997, i.e. after a period of 5 years (Shri. K. Chandran, Bee expert, KVI Board, March 1999, Personal Communication). A survey conducted during 1997-'98 in the southern parts of Kerala, including the Kanyakumari District by KVI indicated the following :

- Only 30% of the colonies have TSBV and larval deaths varied from 5 to 10%
- The percentage of larval deaths (5-10% varied from season to season)
- The incidence of desertion of colonies is very much reduced
- Dequeening is reported to be generally adopted as a measure to
- contain the disease

The reported increase in population of the bee colonies in recent times indicates that such disease epidemics occur in cycles of shorter or longer duration and probably only nature can take care of such calamities.