APPROPRIATE TECHNOLOGY FOR BEEKEEPING WITH APIS CERANA

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HOW TO DESIGN AN APPROPRIATE BEEHIVE

In most of Asia very few efforts has been made to determine the basic factors in designing a hive appropriate to the Asian hive bee (*Apis cerana*). A common problem in Asian beekeeping is the use of hives and management methods designed for western bees (*Apis mellifera*). Lack of appropriate hives and management methods is causing low productivity, poor economy, high absconding rates and high pressure on feral populations of bees.

Most probably a number of the problems, facing beekeeping with *Apis cerana* today, could be solved by using hives designed solely for *Apis cerana*. It is important to realize that the behavior of *Apis cerana* is very different from that of the bees in Europe, Africa or America.No beekeeping knowledge, experience or hive design is transferable from one, to another part of the world, without considering the differences and adapting to the local conditions.

Appropriate to bees

In designing a new beehive there are several technical factors of crucial importance: the volume, the possible comb area, the distance between the combs, the micro climate in the hive, the bees possibility to defend themselves against intruding predators and the sort of materials used for the hive.

It is important to realize, that not one factor, but the interaction between all the factors is decisive for the suitability and productivity of a hive.

Whether a beehive is appropriate to local bees can be decided mostly by measuring quantity, i.e. size of colonies, absconding rate or honey production.

WHAT IS C-C DISTANCE:

Wherever wild bees build their nest, they will always keep a fixed distance depending on their body size - between their combs. It is called the c-c distance, and is measured from the midrib of one comb to the midrib of the next comb.

In a beehive we are providing the bees with frames or top bars, on which they build their combs. It is to make it possible to remove combs from the hive for inspection or harvest of honey without destroying the whole nest. To make sure the bees only build one comb on each frame or top bar, the spacing of frames or top bars must be in accordance with the c-c distance used by the local bees.

Testing results - in a practical manner.

Tests were made in hives fitted with top bars respectively 21 mm, 25.4 mm and 31 mm wide. The 25.4 mm was chosen because it equal to one inch.

The total number of combs build, and the number of combs fixed on more than one top bar were counted for each size of top bars. Combs fixed to more than one top bar were considered as failures.

Figure 2.

% failures in combs with different widths of top bars.

WIDTH OF TOPBAR	21 mm	25,4 mm	31 mm
% FAILURES	78 %	8 %	19 %

THE VOLUME OF THE HIVE - A KEY TO LARGER COLONIES?

The volume of a hive affects the bees behavior. A small volume will soon be filled with combs, crowded with bees and swarming induced.

If a beekeepers purpose of keeping bees is production of honey swarming is undesirable, because half of the bees will leave the hive with each swarm and few bees be left to produce honey. Providing excess hive space can be a way to reduce swarming and shunt resources into honey production.

The Newton hive has a volume of approximately 10.2 liters and is definitely too small to utilize the potentials for profitable beekeeping with *Apis cerana*. The Mulderry hive has a volume of 16.5 liter.

HOW TO GET MORE COMBS IN THE SAME VOLUME.

Efficient use of the volume in a hive - and the materials used for the hive - can help the bees to concentrate less resources on keeping a stable micro-climate in the hive.

When frames are used for *Apis cerana*, the combs are rarely built to fill all the space in the frame. This and the space occupied by the wood used for the frame as well as the space between the frame and the wall of the hive represents a lost opportunity for comb building.

The use of top bars eliminates this problem.

Newton hives

Measuring the mean comb area in Newton hives (frames), it was found to be 260 cm^2 (one side).With seven frames (c-c distance 34mm) in the hive the total comb area is 3640 cm^2.The volume of a Newton hive is 10,2 litres.

The comb area per litre is 357 cm^2

Mulderry hives.

In Mulderry hives (topbars) the mean comb area is 315 cm^2 (one side).With 18 topbars (c-c distance 25,4mm) in the hive the total comb area is 11340 cm^2. The volume of the Mulderry hive is 16,5 litre.

The comb area per litre is 687 cm^2

The comb area per litre seems to be an unnoticed but important factor in hive design

This example shows us how we by changing two factors; the c-c distance from 34 mm to 25.4 mm and giving the bees the possibility to utilize the space in the hive better by using top bars in stead of frames, have achieved nearly the double comb area in the same volume.

A NEW INNOVATION FOR TOP BAR HIVES

Locating beehives in houses provoked a new innovation. To suit needs for easy inspection the base part was made with hinges so it could be opened. This gave two advantages, inspection could be done from below more quickly and without removing the combs and disturbing the bees. It also made it easier to remove wax-debris from combs that had fallen. This was an hygienic advantage because many pests develop in the wax-debris on the bottom board.

SELECTING MATERIALS FOR THE HIVE

The material to be used have to fulfill a number of requirements;

- **# Protect the colony against harsh climatic conditions.**
- **# Allow the bees to keep a stable micro-climate in the hive.**
- **# Protect the bees against predators.**
- **# Be cheap, easily accessible, durable and light weight.**
- **# Preferably something which the local people had skills in using.**

Below some of the characteristics of the new hive are described. It exemplifies how the local skills and knowledge together with modern scientific methods can be meshed to produce the desired results.

A number of traditional techniques used in basket work, boat and housebuilding as well as making fishing net has proved usable for improving the experimental hives.

Bamboo - available everywhere.

The Mulderry hive is a rectangular basket made from bamboo and cane (*Calamus spp.*). The use of bamboo and cane has a long tradition in India. In a warm and humid climate these materials are better suited than wood for many purposes.In hives made from wood, condensing water is often observed to spoil the micro-climate. Cane and bamboo are cheap, available in most areas, and there are widespread traditional skills for working with these materials.

Coating - for fishing nets and beehives.

An outside coating was needed to protect the hive against the monsoon rain and to prevent ants and waxmoths (*Galleria mellonella*) as well as other predators to enter the hive. A female beekeeper suggested to use a technique for coating fishing net. When tested it had the needed quality. This "Mulderry" mixture is made from unripe fruits of Gab (*Diospyros peregrina*) which have been crushed in a ricehusker and then soaked in water for half an hour. The liquid is mixed with

ricehusks and used for coating the outer side of the hive. Left in the sun for one day it dries up and form a water proof and durable coating.
In Nilgiris, experiments in a pilotscale have been tried using tamarind seed paste and clay. Preliminary results are encouraging.

Clay coating - simple, cheap, available and very useful.

Coating the inner side of the hive was necessary to seal cracks and smoothen the surface for hygienic reasons. A coating made from clay mixed with water proved to be a choice serving several purposes. It prevented waxmoths from reproducing in cracks. Measurements on fluctuation of the internal humidity and temperature showed that a clay coating made it easier for the bees to keep a more stable micro-climate in the hive. Most probably the clay coating work as a buffer to stabilize temperature and humidity. This could be a part of the explanation why there is a lower frequency of absconding with clay coating.

Figure 3.
Specifications of Mulderry hives and Newton hives

SPECIFICATIONS	MULDERRY HIVE	NEWTON HIVE
Volume	16,5 liter	10,2 liter
Possible number of combs	18 on top bars	7 in frames
Possible comb area both sides included	11.340 cm^2	3.640 cm^2
C - C distance	25,4 mm (one inch)	34 mm
Comb area per liter	687 cm^2	357 cm^2
Materials	Forest vine/bamboo	Wood
Price	Rs. 155	Rs.450

SUGARS AND FEEDING

Bees store honey to survive during periods where no nectar is available (dearth periods).

If a beekeeper harvest all the honey from a hive, feeding the bees sugar is necessary to replace the lost food reserves. Failing to provide for the bees can cause the colony to die from hunger or abscond the hive.

Apart from being a matter of life or death for a starving bee colony, feeding sugar to bees can be used as a tool by which a beekeeper can:

- **Increase the number of bees in a colony, because the bees respond to sugar feeding by rearing more brood.**
- **Suppress absconding caused by scarcity of nectar.**

Application of these two basic principles can solve a number of problems facing beekeeping with *Apis cerana*.

Sugar is not always sugar.

During the first years in Mulderry, we had to face the same problems as many other beekeepers:

- **colonies absconded due to scarcity of food**
- **colonies were wiped out by predators, because they were too weak to defend themselves.**
- **Wild colonies became scarce in the area because we had to continue capturing to replace colonies lost in the apiary.**
- **The colonies kept in the apiary were too weak for making a decent number of new colonies by dividing old colonies.**

To prevent such obstacles to arise, the importance of sugar feeding has to be stressed.

During experiments with conventional sugar feeding (a boiled solution of 60% sugar and 40% water), I had observed the bees were very slow to take the feeding. If it was possible to improve the conventional sugar feeding, the desired results in the apiary could be achieved much faster.

The need for an improved, ready made feeding lead to the use of inverted sugar in Mulderry Candy and Syrup.

What is inverted sugar?

Bees collect nectar from flowers. The main sugar in nectar is sucrose, which is made up of a molecule of glucose and one of fructose. During the conversion of nectar to honey the bees adds the enzyme invertase (sucrase) to break down the sucrose into glucose and fructose.

The process used by the bees can be imitated by heating a solution of white sugar, water and lactic acid. The processed sugar is called inverted sugar.

Even though the use of inverted sugar has been much debated in western beekeeping with *Apis mellifera* I have found no records of its use in Southeast Asia.

Nevertheless, the use of inverted sugar was a break through in the project that provided the tool to reduce absconding and produce the desired number of large and healthy colonies.

Results:

In figure 4 the size of non-fed colonies is compared to colonies fed with Mulderry Syrup.

The size of a colony is influenced by several factors. To show the interaction between feeding and the choice of hive, results are shown for Mulderry hives as well as Newton hives.Records are shown for 32 colonies; 16 Newton hives and 16 Mulderry hives. In each group the results are calculated as the average of measurements from eight colonies.

Figure 4

Size of non-fed colonies and colonies fed with Mulderry Syrup.

Type of hive:	Non - fed colonies	Colonies fed with Mulderry syrup
Mulderry hives: Mean Brood area per colony /cm²	2.220 cm²	4.188 cm²
Newton hives: Mean brood area per colony /cm²	1.014 cm²	2.555 cm²
Mulderry hives: Total comb area per colony /cm²	5.050 cm²	6.733 cm²
Newton hives: total comb area per colony /cm²	2.795 cm²	3.566 cm²

A significant difference of the mean brood area and the total comb area was found between non-fed colonies and colonies fed with Mulderry Syrup:

- **300 % more brood (and bees) were found in Mulderry hives fed with Mulderry Syrup than in non-fed Newton hives.**
- **In Newton hives fed Mulderry Syrup the mean brood area increased 150 %.**
- **The total comb area in colonies fed Mulderry Syrup is approximately 100 % larger in Mulderry hives than in Newton hives.**

Even though feeding the bees is only one factor interacting with other, the introduction of Mulderry Syrup and Candy has played an important role in the results achieved in the project.