

out at the time of harvest in December—January all promising and tender side shoots not fit for milling and giving a ploughing and an irrigation if possible. This not only results in the rapid growth of the shoots thus left, but also stimulates a fresh flush of shoots some of which grow sufficiently well to give 3 or 4 setts by the time of planting (March—May). Even shoots which do not form sufficient nodes for being cut into setts but vigorous enough are found fit enough for planting. Sufficient shoots could thus be obtained for double or treble the area thus treated. Even under adverse conditions sufficient seed material to plant an equal area can easily be got. In areas where Co. 213 is largely grown this method has of late become rapidly popular, obviating the necessity for a separate short crop altogether, and the practice is well worth copying in other districts where similar conditions prevail.

PRACTICAL HINTS ON BEE-KEEPING*

BY M. C. CHERIAN & S. RAMACHANDRAN

I. Introduction. In these days of economic depression the income from agriculture is poor and the ryot, therefore, has to look to other sources to enhance his earnings. Taking into consideration the poverty of the average Indian ryot and his consequent inability to invest large sums on new ventures, bee-keeping on improved lines can be safely recommended as a paying cottage industry, as it involves only a small outlay. Moreover there is no dearth of bees or of bee-pasturage crops in this Presidency. Preliminary trials have shown that a colony of bees, under favourable conditions, is capable of yielding a net profit of about Rs. 10 to 15 per annum and as such there are great possibilities for this new industry.

II. Selection of Bees for rearing. Enormous profits are derived in the temperate regions by rearing the European bees, but their progress, apart from the prohibitive cost of importing them, has not been very encouraging in this country. Of the indigenous bees, the 'Rock' bee which is the biggest of the Indian honey bees and found mostly on the hilly regions, is unfit for domestication, because of its peculiar comb-building and migratory habits and ferocious temper. The 'Little' bee also has been found unfit for rearing, as it is migratory in habits and a poor honey gatherer. The Dammar bee, the smallest of the indigenous bees, is also not reared because of its poor honey gathering capacity. The only bee that can, with advantage be domesticated is the 'Indian bee'. It is smaller in size than the Rock bee and constructs its combs in parrallel rows inside natural hollows in tree trunks and in the ground, cracks and crevices in buildings, old pots etc. It is a fairly good honey gatherer and is comparatively mild in temper. The present paper therefore deals only with the Indian bee.

* This pamphlet has been prepared for the Honey Week.

III. Food of Bees. Honey and pollen are the most important bee-foods. Both of these are available from flowers and the plants that provide these bee-foods are spoken of as bee-pasturage crops. The following are the important bee-pasturage crops observed round about Coimbatore:—Pollen yielders:—Maize, cholam, cumbu, castor, sunflower, peltophorum, zinniah, palmyrah, coconut, niger, cucurbitaceous plants. Nectar yielders:—Different varieties of cotton, tamarind, margosa, sunflower, plantains, niger, pungam, raintree, antigonon, white babool, drumstick tree etc.

IV. The Bee Hive. The artificial bee-hive is a miniature house designed to accommodate a bee-colony. There are various types of these hives, but in South India the most popular pattern is the Newton Hive. This consists of a brood-chamber and a super, with a floor board below and a top above. The brood chamber consists of a rectangular box open at the top and bottom and provided with a movable floor board below. It contains seven movable frames to support the combs. The super is a separate compartment meant for storing honey only and is kept over the brood-chamber when the latter is full of bees. The top is placed on the brood-chamber or the super as the case may be. Measurements of the various parts are given below:—

| | | | | |
|---|-----|-----|-----|--|
| Floor-board | ... | ... | ... | 14" by $9\frac{1}{2}$ " |
| Brood-chamber—inner measurements | ... | ... | ... | $9\frac{3}{4}$ " \times $8\frac{1}{4}$ " \times $6\frac{3}{4}$ " |
| Width of groove along the top of the front and rear planks of the brood-chamber to support the frames | ... | ... | ... | $\frac{1}{4}$ " |
| Entrance to be cut along the lower side of the front plank of the brood-chamber | ... | ... | ... | $3\frac{1}{2}$ " \times $\frac{3}{8}$ " |

Measurements of the brood frame:

| | | | | |
|---------------------------------|-----|-----|-----|------------------|
| Breadth of top bar | ... | ... | ... | $\frac{7}{8}$ " |
| Length of top bar | ... | ... | ... | 10" |
| Thickness of the top bar | ... | ... | ... | $\frac{1}{8}$ " |
| Inner length of frame | ... | ... | ... | $8\frac{1}{4}$ " |
| Inner height of the frame | ... | ... | ... | $5\frac{3}{4}$ " |
| Total height of frame | ... | ... | ... | 6" |
| Length of side bar | ... | ... | ... | $5\frac{3}{4}$ " |
| Width of side bar at the top | ... | ... | ... | $1\frac{1}{8}$ " |
| Width of side bar at the bottom | ... | ... | ... | $\frac{1}{2}$ " |

The top bar should be fixed exactly at the centre of the side bar so as to effect a clearance of exactly $\frac{1}{8}$ " on either side. The length and breadth of the super are the same as those in the brood-chamber, but the height is only $3\frac{1}{8}$ ". Measurements of the super frames also are similar to those of the brood frames but the inner height is only $2\frac{1}{2}$ ".

The top is made to suit the hive body and a hole is provided in the front and rear planks and a big opening about 3" square in the ceiling plank to provide ventilation. Care should be taken to close all these openings with thin wire gauze.

V. Hiving wild Colonies and Swarms. After making a few hives the amateur should think of filling these with bees. This can be achieved either by capturing *wild colonies* or by *hiving swarms*. Wild colonies are generally found in enclosed spaces such as hollows in tree trunks, cracks and crevices in walls, old pots and the best way of locating them is by observing the likely places on bright mornings when numbers of bees will be seen going in and coming out of the burrows. Prior to the actual capture of the bees the entrance should be widened and the combs taken out gently one by one. Good-sized combs having plenty of brood should be selected and fixed to the frames with plantain fibre. The bees can then be induced to come to the hive by capturing the queen in a glass tube and placing it over the frames, after having closed its mouth with a piece of mosquito-net. In the absence of a tube, the queen can be caged in an empty match-box, care being taken to have it partially open. When the majority of the bees have entered the hive the queen can be liberated. In cases where the queen is not captured, clusters of bees that would, by this time, have collected inside the hollow can be scooped and transferred to the hive. The queen will, invariably, be found among these bees. Since the bees are likely to sting when being handled a few occasional whiffs of smoke from burnt rags may be necessary to quieten them.

VI. Hiving Swarms. Swarms are small groups of bees each with a queen, which issue from established colonies during the honey flow season and settle in some convenient place for a time in the shape of a bag-like cluster. Later on, these bees move away to some convenient place of abode and start a fresh colony. If one has a few colonies their number can easily be increased by hiving such swarms and keeping them separate. The capture can be effected by getting a new hive with the frames removed and placing in it a good brood-frame taken from one of the settled colonies. If the swarm is from the particular hive, from which the brood-comb has been taken, it can be given with the bees, if not, the bees have to be driven away. In either case, care should be taken to see that there are no queen cells in the comb. The hive should be held in such a way that a major portion of the cluster is inside the box. The bees, being attracted to the brood, quickly transfer themselves to the hive. The remaining frames and the top can now be put on and the hive kept at some distance away from the original colony.

VII. After-care of Newly Captured Colonies and Swarms. Wild colonies should, as far as possible, be hived only during the brisk breeding season, since the presence of the brood in the combs induces

the bees to settle in the artificial hive. Fresh captures should not be disturbed frequently, except for an occasional cleaning of the floor-board. Weak colonies should be fed with either dilute honey or thick sugar syrup. The frames should be examined after about a fortnight and the pieces of plantain fibre removed. Combs that have been improperly fixed and those that have dropped down must be refixed. The progress of the colony should be carefully watched and if egg-laying is not satisfactory, a brood-comb from another colony may be given. There is always the risk of the bees deserting the hive until they settle down to their normal routine of brisk pollen, honey collection and brood rearing. Such desertions can be prevented by the use of a queen arrester. This is a simple contrivance consisting of a piece of wood, longer than the entrance of the hive with a shallow cut about $\frac{1}{8}$ " deep and just as long as the entrance. It is kept close to the entrance with the cut end below. The narrow slit is enough to allow the workers but not the queen and bees do not, as a rule, swarm out without their queen. The same precautions hold good for the newly hived swarms but a few additional old or foundation combs may be given to save the time and energy of the bees.

VIII. Location of the Apiary. An Apiary should be started only in a locality where there is plenty of bee-pasturage. Care should be taken to keep the hives absolutely level, in a place which is well protected from the hot sun, heavy rains and high winds.

IX. Handling Bees. Bee-hives should be opened and examined only on bright mornings when most of the bees are busy. Quick and nervous movements, incidental crushing of bees should be carefully avoided while handling the frames. The sting is fairly painful but the pain and the attendant swelling can be considerably minimised if the sting, which is left behind, is scraped away immediately. When the bees are in a bad mood they can be quietened by a judicious use of smoke.

X. Swarming and its control. Swarming in bees is the natural method of distribution and perpetuation of their kind. This instinct is very strong in bees and steps should be taken to check the impulse, since colonies get considerably weakened by the frequent issue of such swarms. This family separation occurs only during the prosperous season but the actual period may vary according to the locality. Prior to sending out swarms, the colonies multiply rapidly and the initial preparation for swarming is evinced by the excessive rearing of drones. This is followed by the erection of queen-cells along the lower border of the brood-combs and a series of swarms issue after these queen-cells are sealed. The most popular method of preventing the issue of swarms is the periodical cutting of the queen-cells. Another method which shows better promise is the destruction of the reigning queen or her removal with a comb of bees to a separate hive,

after the queen-cells in the original colony are sealed. The colony is kept under careful observation and all the other queen-cells are cut away after the new queen has emerged. The swarming impulse is lessened when the colony remains without a queen for a few days. Neither of the two methods mentioned above can claim to entirely cure the bees of their swarming fever. A third procedure may be adopted provided the conditions are favourable. If the swarming impulse is evinced early in the honey season, the first swarm may be allowed to issue and it may be hived and kept as a separate colony. The rest of the queen-cells should be removed after the emergence of the fresh queen. The owner in this case gets two colonies out of one and both of them may yield honey in the first year itself if pasturage conditions are favourable.

XI. Care of colonies during the lean season. Owing to adverse pasturage and weather conditions during certain seasons, the queen reduces her rate of egg-laying and the population of the colony dwindles in strength. Under such circumstances, the bees may be fed artificially either with dilute honey or thick sugar syrup, by pouring a small quantity of the fluid over the frames once or twice a week. The feeding may be stopped as soon as a sufficient quantity of honey is found stocked in the combs.

Bee enemies such as the wax-moth, the black ant, the yellow banded wasp, and the death's head moth are very active during the slack season and necessary steps should be taken to check them. Of these the *wax-moth* is the worst enemy of bees. The caterpillars attack the combs and bees in the infested colonies very soon desert the hives. The following hints may be helpful in controlling this pest. All attempts should be made to keep the colony strong as such a condition enables them to withstand the ravages for a longer time. All superfluous combs are to be removed and stocked in an air-tight receptacle. A mud pot with its mouth sealed with cow-dung serves the purpose quite well. The combs should be frequently examined and those showing traces of damage should be promptly destroyed. The floor-board as well as the other parts of the hive should be kept clean. Pieces of discarded combs should not be thrown about carelessly. Necessary precautions should be taken to see that there are no cracks and crevices in the hive body. The interspaces between the brood-chamber, super and top should be examined for the egg-masses and if present should be scraped away. If there is a suspicion that the eggs have been laid in any of the inaccessible crevices, the hive body may be changed frequently. Combs that are stored for the next season's use are also likely to be attacked. The caterpillars infesting these combs can be easily eliminated, by exposing the latter to the morning sun, for about fifteen minutes, taking care to see that the temperature does not exceed 40° centigrade.

Another enemy that has to be guarded against is the *black ant*. These ants are particularly troublesome after the rains; sometimes causing wholesale damage to bee colonies by snatching away numbers of bees, very often grubs and pupae also. The pest can be easily controlled by dropping a few granules of calcium cyanide inside the ant holes. The hives can be kept on stands that have been provided with ant-pans. Occasionally bee colonies are visited by the *yellow banded wasp* and numbers of bees are snatched away. The wasps can be hand-netted and killed. Nests of these wasps can also be searched out and burnt during night time. *Death's head moths* occasionally enter bee-hives and steal away a good quantity of honey. Generally the bees themselves kill these moths after their entrance into the hive, but it is better to destroy them wherever they are found.

XII. Care of colonies during the breeding season. Since a strong population is essential for gathering plenty of honey, necessary facilities should be given for the rapid increase of bees during the breeding season. Old combs taken out and stored during the previous season may now be given at the centre and if these are not available, the combs at the sides, which are generally stocked with honey, may be transferred to the centre. This treatment apart from providing the necessary egg-laying space and stimulating the rate of egg-laying by the queen, also saves the time, energy and honey of the bees, which would otherwise be wasted in constructing fresh combs. Since weak colonies do not yield much honey, two or three of them may be united and built up as one strong colony. If this is not desired, the population of a weak and a strong colony can be equalised by inter-changing the position of the two hives on a bright morning when the bees are working briskly. The super may be added when the bee population has become strong enough to cover all the seven combs in the brood-chamber. The provision of spare combs to the super also is necessary so as to encourage the bees to come up and store honey. If spare combs are not available, the two side combs of the brood-chamber may be taken out, cut to the size of the super frames and fixed on to them.

XIII. Uniting colonies. This operation consists of uniting two or three colonies into one and it may be done for mixing a queenless colony with another having a queen, uniting two or more weak colonies to make a strong one. There are various methods of uniting but the simplest, which is popularly known as the "newspaper method," is described below:— The colonies that are to be united are brought side by side (as described under shifting bee colonies) and one of them dequeened twentyfour hours prior to the uniting. Late in the evening the colony having the queen is opened and the top of it is covered with a sheet of newspaper. A few small holes are made in this paper. The floor-board of the other colony is now removed and

the hive is kept over the newspaper. All means of escape are now closed with wire-gauze and the two colonies left alone for the night. The imprisoned bees in both the hives, scenting the presence of strangers, begin to investigate by tearing open the holes in the newspaper and by this time the hive-odor gets amalgamated and the union of the two colonies is accomplished. The wire-gauze at the entrance of the lower hive can be removed early next morning. The hives can be opened after the weather gets brighter and the frames of both the colonies can be kept together.

XIV. Queenless colonies. It is very common for colonies to lose their queens during the swarming season. This is due to the queens either getting lost or preyed upon by insectivorous birds during their nuptial flight. The absence of the queen is indicated by the slackness of work in the colony. The workers get their abdomens contracted, turn black in color and they can often be seen remaining huddled together at the entrance. The combs do not contain any worker brood but in most cases, numbers of eggs laid by some of the workers, may be found in each cell. Under such circumstances all the superfluous eggs are removed and even transported to other cells made by the bees. Since the workers are not fertile, the grubs that hatch out of their eggs develop only into drones. The combs get twisted in shape on account of the unequal pressure caused by the presence of the larger drone grubs in the smaller worker cells. In neglected cases numbers of adult drones also will be found. To provide a new queen for such a colony, a comb with a sealed queen-cell from another colony may be given, after driving away the bees adhering to it. The bees may sometimes tear away the queen cells and in such cases a new queen may be introduced by the following method. Dip the queen in honey and drop her into the queenless colony, pouring a small quantity of honey along with her. The workers immediately cluster round the queen and begin to lick the honey. The smell of the latter which attracts the bees, probably neutralizes the individual odour of the queen. Therefore by the time she gets rid of her coating of honey she is accepted by the colony. If the above methods are not successful, the colony may be united with another having a queen. Whatever may be the method adopted, necessary steps to requeen such queenless colonies should be taken, immediately after the loss of the queen is noted, since the bees sometimes refuse to accept either a queen-cell or a queen if there is any undue delay.

XV. Shifting bee colonies. Bees have a very strong homing instinct. Powers of good perception and a strong memory of the landmarks enable them to fly back to their hives with unerring exactness, from their foraging excursions. When the bees are working briskly, if the hive is moved even by a few inches, it takes a little time

for the returning foragers to find out the entrance. If the hive is moved by four or five feet, the bees returning with pollen and nectar persistently hover about the original place until they drop down and die of exhaustion. Therefore if the hive is to be shifted from one place to another within the apiary itself, the moving should be done after sunset by about two feet per day. If it is necessary to shift the colonies to a distance, the entrance is closed with wiregauze after nightfall and the hive taken to the desired place and the entrance opened. The minimum distance to which the bees can be moved, without any of the workers returning to the original place, is about half a mile. Frequent shifting of bee colonies should be avoided, since, it always entails the loss of a number of bees.

XVI. Honey and its extraction. Bees generally collect nectar from flowers, convert it into honey and store it in their cells. After the cells are filled with the requisite quantity of ripe honey, they are sealed with wax. Honey should be extracted only after 75% of the cells are sealed. Prior to the extraction, the bees that are found adhering on the honey combs may be driven away by the following method. The frames are to be taken out and kept in an empty hive without the top and the floor-board. The box is held in such a way that the top of the front side of the box is just touching the end of the floorboard and smoke is applied from below. The bees, being frightened by the smoke will all rush into the hive. After driving away the bees, the sealed combs should be uncapped with a sharp knife and the honey extracted in the honey-extractor. The latter consists of a cylindrical drum and a box to hold the honey combs. The box is fixed to a rotating rod at the centre and the revolution is effected by the action of a set of two gear wheels on the central rod. The frames containing honey are kept in the slot provided in the comb-box and the latter is rotated. After the honey on the outer side of the comb is extracted the frame should be reversed and the honey on the other side taken in a similar way. The box should be rotated gently at the beginning and the speed increased after the weight of the combs is reduced. Heavy combs are likely to break if the rotation is too fast at the beginning itself.

XVII. Ripening and Storing of Honey. Ordinarily bees seal the sells with wax as soon as they are filled with "ripe honey", but occasionally they take a long time to close the cells. In such cases, the honey can be extracted before the sealing, but it has to be ripened artificially prior to storing, as described below:—

The honey has to be poured preferably in an enamel or earthen vessel and the latter kept in a water-bath. The water should be heated up to 150°F., and maintained at that temperature for about half an hour. The water should not be allowed to boil nor can honey be heated directly over fire. The ripening can also be done by

exposing the honey in a wide mouthed vessel to the hot sun for about a week. The mouth of the vessel may be covered with a piece of thin cloth to keep off dirt etc. The ripened honey is best stored in glass or enamel or earthen vessels. The receptacles should be closed tightly and kept in a cool and dark cellar.

XVIII. A few hints for amateur bee-keepers. The following hints may be useful for beginners in maintaining their apiaries successfully:—

1. Make the bee hives without cracks and crevices so as to prevent the wax-moth from laying eggs in these.
2. See that the measurements of and spacing in the frames are correct. Any error will induce irregular comb construction.
3. Hive wild colonies during the brisk breeding season since colonies caught during the slack season invariably desert.
4. Locate apiaries in places where pasturage conditions are favourable.
5. Keep the hives absolutely level in a place well protected from the midday sun, rain and high winds.
6. Do not disturb newly-hived colonies frequently.
7. If there is not sufficient honey flow, feed new colonies with dilute honey in the absence of which sugar syrup or jaggery solution may be used.
8. Give the food inside the hive. If the food is kept outside the hive, it often leads to fighting and robbing among bees. Do not over-feed the bees.
9. Examine colonies during bright mornings when bees are busy ; otherwise they might sting badly. When stung do not pull out the sting but scrape it off immediately. Rub some green leaf over the part stung to cover the smell.
10. Avoid all jerky and nervous movements while handling bees.
11. When bees are in a bad mood a few whiffs of smoke would quieten them.
12. Do not shift colonies from place to place frequently.
13. As the colony increases in strength, provide additional egg-laying space for the queen by giving foundation or old combs.
14. When brood chamber is full, give super with combs.
15. During the heavy breeding season, be on the look out for queen-cells and for the subsequent issue of swarms. Allow the prime swarm, if it issues early in the season, and hive it as a separate colony. Do not allow any "after swarms."
16. Build up the strength of the colonies prior to the honey season by swarm prevention, requeening, uniting weak stocks, and by provision of breeding facilities.
17. Extract honey when 75% of the cells are sealed and ripen the honey artificially. Do not extract the honey from the brood-chamber.

18. Beware of the wax-moth the worst enemy of the honey bee. To control it keep the colonies strong. Remove all superfluous combs and give just enough for the bees. Examine the joints and interspaces of the hive body for eggmasses of the wax-moth. Scrape away the eggmasses and if necessary change the hive-body once in 6 days. Examine the combs and floor-board of the hive for caterpillars. Store the old combs in an air-tight and insect-proof receptacle. Examine them frequently and if infested by the worms dry them in the sun and eliminate the caterpillars.

19. The black ant is another serious enemy; treat the ant holes with calcium cyanide. Provide ant pans or smear the legs with Tanglefoot.

20. The yellow banded wasp is also known to attack bees. Handnet the wasps. If possible destroy their nests.

Detailed information on the subject of bee-keeping is given in Bulletin No. 37 of the Madras Agricultural Department. For further information the Government Entomologist, Lawley Road P. O., Coimbatore. may be written to.

Research Notes.

The Relationship between the Mechanical Tissue Brown Factor and the Factor for Juiciness of Stalk in Sorghum.

In a previous paper¹ the occurrence, as a mutant, of a sorghum plant with brownish purple-lined internode, leaf-sheath, midrib, panicle branch, and glume top has been recorded. The pigment was not anthocyanic. This mutant behaved as a simple recessive to the common more economic green-internoded and white midribbed plant. A factor mt_b gives a mechanical tissue coloured brownish purple. Mt_B gives the ordinary green internode of the common sorghum.

In another paper² Mendelian di-hybrid segregations for the character pairs pithy and juicy stalks (D-d), and not sweet and sweet stalks (X-x) proving them independent in inheritance have been reported.

To determine the inter-relationship between the colouring of the mechanical tissue and such an important factor as juiciness in stalk, crosses were made between the following parents.

| A. S. 545 | A. S. 3641 |
|--|---|
| Sweet Stalk (x) | Sweet stalk (x) |
| Juicy stalk (d) | Pithy stalk (D) |
| Mechanical tissue colourless (Mt_B) | Mechanical tissue brownish purple (mt_b) |

The F_1 (A. S. CCXXII—a) was sweet stalked (xx), pithy stalked (Dd) and its mechanical tissue was colourless ($Mt_B - mt_b$). In the F_2 the following di-hybrid segregations were obtained.