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Survey studies: Integral approach towards the diseases and enemies of *Apis mellifera* L. in upper and lower hills of Himachal Pradesh: Beekeepers prospective

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Abstract

Survey studies were conducted from six districts (Kullu, Kinnaur, Sirmaur, Solan, Shimla and Una) of Himachal Pradesh during July 2015 to June 2016 to know the status of rearing of *Apis mellifera* L. colonies both as stationary and migratory conditions. *Callistemon lanceolatus*, *Eucalyptus* spp. *Toona ciliata*, *Rosa moschata*, *Zizyphus jujuba*, *Acacia catechu*, *Aesculus hippocastanum* and *Trifolium repens* etc. are the major honey flow sources of Himachal Pradesh. Sarson (Una, Nalagarh and Solan), eucalyptus (Una and Nalagarh), horse chestnut (Shimla, Kullu and Kinnaur) and wild clover (Shimla, Kullu and Mandi) are reported as sources of honey production in the state. Seasonal incidence of brood diseases, ectoparasitic mites and enemies of *A. mellifera* under stationary and migratory conditions were changing from location to location and place to place. The period of incidence of European foulbrood was different in Kullu (April-May), Solan (May-June) and Sirmaur (June-July) districts. Nosema disease infestation was observed by beekeepers during May- June at Una and August-September at Nalagarh (Solan). Among enemies, bear and lizard were observed by beekeepers to attack *A. mellifera* colonies during different timings of year. Bear was reported as a major problem in Kinnaur area (Telangi and Reckong Peo) during May to July. *A. mellifera* colonies migrated to Kinnaur were also attacked by lizard in May-June. As per as concerned with the management of *Varroa*, beekeepers are using sulphur (Nalagarh, Kinnaur, Kullu and Lahaul and Spiti), Thymol (Nalagarh and Kinnaur) and Formic acid (Bajaura) in *A. mellifera* colonies. Survey studies revealed that beekeepers of Himachal Pradesh are aware about the different management practices against various diseases, mites and enemies of *A. mellifera*.

Keywords: Bee flora, beekeepers, *Apis mellifera*, diseases, enemies

1. Introduction

The beekeeping with European honey bee, *A. mellifera* is practised in state as migratory beekeeping. At present, there are more than 1500 beekeepers having about 1 lakh bee colonies and producing 1700 MT honey in low to high hills of the state (Anonymous, 2013) [1]. Beekeepers keep their colonies from April to October in Himachal Pradesh and migrate to plain areas of Haryana, Punjab, Rajasthan and Uttar Pradesh during rest of period of the year. One of the problems faced by beekeepers in the state is presence of various pests, predators and pathogens which impair the health and normal working of honey bees. The knowledge about the seasonal incidence of various diseases and enemies of *A. mellifera* under changing scenario is not accomplished. Current study was aimed for the surveillance of diseases and enemies of *A. mellifera* and their management practices.

2. Materials and Methods

The present study was carried from July 2015 to June 2016 in *Apis mellifera* L. colonies maintained by the beekeepers of Himachal Pradesh at six different localities namely: Kullu, Kinnaur, Sirmaur, Solan, Shimla and Una which is situated in uppers and lower hills of Himachal Pradesh. The climate of district is pleasant around the year except in plains like Una and nearby areas. Monsoon sets in the first week of July and continues till mid September. They are extremely cold in winter. Various agricultural crops, vegetables and fruits are grown in these 6 districts. Agriculture forms the backbone of the district economy. Questionnaires were prepared and data was collected according to research proposal (Appendix-VII) from randomly selected beekeepers in the districts.

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Information about number of colonies, bee flora, honey flow sources and migratory route was gathered from the beekeepers. Apart from this major focus were taken on the another 2nd objective regarding management practices adopted by beekeepers for the management of bee diseases and enemies on followings:

- Name of diseases/ enemies experienced by beekeeper
- Period of incidence of disease/enemy
- Loss of colonies (if any) due to disease/enemy attack etc.
- Management practices adopted by bee keeper for various diseases/enemies.

3. Results and Discussion

Survey studies were carried out in six districts of Himachal Pradesh to record the management practices adopted by beekeepers of Himachal Pradesh for different diseases and enemies of *A. mellifera*. The information was collected from beekeepers of Kullu (8), Kinnaur (8), Sirmaur (6), Solan (3), Shimla (3) and Una (2) districts on bee flora and awareness

about incidence and management of diseases and enemies.

3.1 General information

The information collected from beekeepers of Himachal Pradesh showed that beekeepers are maintaining 50-600 colonies of *A. mellifera* as migratory beekeeping. They were migrating their colonies to Haryana, Rajasthan, Punjab and Uttar Pradesh. Many of these beekeepers were renting their colonies for apple pollination in Shimla, Kullu and Kinnaur districts of the state. They were charging Rupees 600-800 per colony for renting these colonies for about one month period.

3.2 Bee flora

Important sources of bee flora reported by beekeepers in the state included fruit trees, vegetable crops and wild flora (Table 1). Fruit tree namely apple, almond, apricot, peach, ber, pear and plum provided abundant nectar and pollen which help in the buildup of colonies.

Table 1: Important bee flora of different districts of Himachal Pradesh

Sr. no	Common name**	Scientific name	Family	Area
1	Almond	<i>Prunus amygdalus</i>	Rosaceae	Kullu, Kinnaur
2	Apricot	<i>P. armeniaca</i>	Rosaceae	Solan, Kullu, Kinnaur
3	Peach	<i>P. persica</i>	Rosaceae	Sirmaur, Solan
4	Pear	<i>Pyrus communis</i>	Rosaceae	Kullu, Kinnaur, Shimla, Sirmaur
5	Plum	<i>Prunus domestica</i>	Rosaceae	Sirmaur, Kullu, Shimla, Solan
6	Barberry	<i>Berberis lycium</i>	Berberidaceae	Shimla, Theog, Solan
7	Apple	<i>Malus domestica</i>	Rosaceae	Shimla, Theog, Tabo, Kinnaur
8	Cauliflower	<i>Brassica oleracea</i>	Cruciferae	Una, Nalagarh,
9	Eucalyptus*	<i>Eucalyptus spp.</i>	Myrtaceae	Una, Nalagarh
10	Bottle brush*	<i>Callistemon lanceolatus</i>	Myrtaceae	Una, Solan, Nalagarh
11	Daru	<i>Punica granatum</i>	Punicaceae	Solan, Sirmaur
12	Toon*	<i>Toona ciliata</i>	Meliaceae	Solan, Sirmaur
13	Wild rose*	<i>Rosa moschata</i>	Rosaceae	Solan, Sirmaur, Shimla, Kinnaur
14	Ber*	<i>Zizyphus jujuba</i>	Rhamanaceae	Una, Nalagarh
15	Khair*	<i>Acacia catechu</i>	Mimosaceae	Solan, Una
16	Thorn Apple	<i>Datura stramonium</i>	Solanaceae	Theog, Shimla
17	Bathu	<i>Chenopodium album</i>	Chenopodiaceae	Una, Nalagarh
18	Maize	<i>Zea mays</i>	Graminae	Una, Solan
19	Sarson*	<i>Brassica campestris</i>	Cruciferae	Una, Nalagarh, Solan
20	Wild cherry	<i>Prunus puddum</i>	Rosaceae	Shimla, Theog
21	Toria	<i>Brassica rapa</i>	Brassicaceae	Una, Nalagarh
22	Sunflower	<i>Helianthus annuus</i>	Asteraceae	Una
23	Coriander	<i>Coriandrum sativum</i>	Apiaceae	Una
24	Horse chestnut*	<i>Aesculus hippocastanum</i>	Sapindaceae	Shimla, Kullu, Kinnaur
25	Shisham*	<i>Delbergia sisoo</i>	Fabaceae	Kangra, Una, Nalagarh
26	Wild clover*	<i>Trifolium repens</i>	Febaceae	Shimla, Kullu, Mandi
27	Simbal	<i>Bombax ceiba</i>	Malvaceae	Kangra
28	Reetha	<i>Spindus mukorossi</i>	Sapindaceae	Kangra
29	Litchi	<i>Litchi chinensis</i>	Sapindaceae	Kangra
30	Jangli ajwain	<i>Trachyspermum ammi</i>	Apiaceae	Lahaul and Spiti

*Major honey flow sources, **as per information given by beekeeper.

The sources of surplus honey production varied in the state. Sarson (Una, Nalagarh and Solan), eucalyptus (Una and Nalagarh), horse chestnut (Shimla, Kullu and Kinnaur) and wild clover (Shimla, Kullu and Mandi) are reported as sources of honey production.

3.3 Incidence of diseases, *Varroa* mite and enemies experienced by beekeepers

The information was also collected from beekeepers on the incidence of diseases, mites and enemies in honey bee

colonies along with their period of incidence, percent infestation and loss of colonies (Tables 2 and 3).

The incidence of European foulbrood has been reported from April to July, when *A. mellifera* colonies are migrated back in Himachal Pradesh. According to beekeepers, the period of incidence of European foulbrood was different in Kullu (April-May), Solan (May-June) and Sirmaur (June-July) districts. Nosema disease infestation was observed by beekeepers during May- June at Una and August-September at Nalagarh (Solan).

Table 2: Incidence of diseases and *Varroa* mite experienced by beekeepers

S. No.	Disease/ enemy	Causal organism	Area	District	Period of incidence (Month)	Colonies with disease/mite infestation (%)
1	European foulbrood	<i>Melissococcus plutonius</i>	Bajaura	Kullu	April – May	25.00
			Ghadych,	Solan	May – June	28.00
			Ghandhuri	Sirmaur	June- July	24.00
2	Nosema	<i>Nosema spp</i>	Una	-	May – June	12.00
			Nalagarh	Solan	August-September	10.00
3	<i>Varroa</i> mite	-	Maithal	Solan	June – July	25.00
			Saori	Solan	May – June	22.00
			Kasari	Solan	March – April	24.00
			Reckong Peo	Kinnaur	April – May	12.00
			Tabo	Lahaul and Spiti	March – April	20.00
			Telangi	Kinnaur	March- June	20.00

Varroa destructor infestation was observed by large number of beekeepers from March-July. *V. destructor* was noticed by beekeepers from March-July in Nalagarh area of Solan. The period of mite appearance differed in other areas being March-April (Lahaul and Spiti), March -June (Kinnaur) and April-June (Kullu).

Among enemies, bear and lizard were observed by beekeepers to attack *A. mellifera* colonies during different timings of year. Bear was reported as a major problem in Kinnaur area (Telangi and Reckong Peo) during May to July. *A. mellifera* colonies migrated to Kinnaur were also attacked by lizard in May-June. Lizard also caused nuisance to colonies during May-June in Telangi and Reckong Peo areas of Kinnaur.

Beekeepers reported high incidence of diseases and mites in

A. mellifera colonies. European foulbrood disease infestation in *A. mellifera* colonies was reported by beekeepers. According to them, (Appendix-VIII) European foulbrood infestation in honey bee colonies varied in Bajaura (25% colonies), Ghadych (28%) and Ghandhuri (24%). Nosema disease was noticed in Nalagarh (10% colonies) and Una (12%). *V. destructor* mite was reported from six locations. It infested 12% colonies in Reckong Peo (Kinnaur) to 25% colonies in an apiary at Maithal (Solan).

Bear attack is a major problem faced by beekeepers while colonies are migrated to high altitudes. According to beekeepers, 10% colonies in Telangi (Kinnaur) and 8% in Tabo (Lahaul and Spiti) were completely damaged due to bear attack.

Table 3: Incidence of enemies experienced by beekeepers

S No.	Enemy	Area	District	Period of incidence (Month)	Colony damaged (%)
1	Bear	Telangi	Kinnaur	June – July	10.00
		Tabo	Lahaul and Spiti	May – June	8.00
2	Lizard	Telangi	Kinnaur	May - June	-
		Reckong Peo	Kinnaur	May – June	-

3.4 Management practices adopted for diseases and enemies

Beekeepers are applying different chemicals for management of diseases in *A. mellifera* (Table 4) Terramycin and Tetracycline are used for management of European foulbrood disease in Sirmaur and Solan area. One of the beekeepers in Kullu is using Formic acid for the management of European foulbrood. Beekeepers from Una and Nalagarh are feeding sugar syrup (50%) for management of Nosema disease for *A. mellifera* colonies

For the management of *Varroa*, beekeepers are using sulphur (Nalagarh, Kinnaur, Kullu and Lahaul and Spiti), Thymol (Nalagarh and Kinnaur) and Formic acid (Bajaura) in *A. mellifera* colonies.

For the management of wasps, all the beekeepers are using flapping method to kill wasps. Fencing technique around apiary by wire is adopted for management of bear in Kinnaur and Lahaul and Spiti. Flapping is also used by beekeepers of Kinnaur for scaring lizard.

Table 4: Management practices adopted by beekeepers for diseases, *Varroa* mite and enemies of *A. mellifera*

S No.	Disease/ enemy	Management practices adopted by beekeepers
1	European foulbrood	Terramycin 0.2g in 500ml concentration of sugar syrup
		Tetracycline @ 200mg/colony
		Formic acid and Methyl (5ml/10frames)
2	Nosema	Sugar syrup (50%)
3	<i>Varroa</i> mite	Sulphur dusting
		Sulphur dusting and Thymol
		Formic acid and Sulphur dusting
4	Bear	Wire fencing
5	Lizard	Flapping

The information collected from *A. mellifera* beekeepers of Himachal Pradesh indicated that they are aware of important bee flora, diseases, mites, enemies and their management practices. No such survey was earlier conducted in the state. The important bee flora reported by beekeepers has been mentioned as major honey flow sources under previous

studies conducted in state (Sharma and Raj, 1985; Garg, 1989; Sharma and Gupta 1993; Kumar and Kashyap 1996 and Rana *et al.* 1997) [6, 2, 5, 3, 4]. The important diseases, *Varroa* and enemies observed by beekeepers have also been discussed while describing the status of beekeeping in Himachal Pradesh (Rana *et al.* 2011) [5]. They reported 40 percent of

brood killing during few months of year on account of *Varroa* mite. 10 percent brood mortality was reported due to European foulbrood incidence. Beekeepers of the state are adopting safe methods for management of diseases and enemies. However, the practice of feeding antibiotic for the control of European foulbrood and *Varroa* mite is still adopted inspite of scientific advice given to beekeepers for avoiding feeding of antibiotic since it effects honey market and causes allergic reactions in human beings (Rana *et al.* 2011) [5]. Only one beekeeper of the state is adopting wrong management practices (Table 4), where he used formic acid for control of European foulbrood.

4. Conclusion

There is lack of information on survey studies conducted to gather information from beekeepers of the state. The abundance of bee flora is present Himachal Pradesh which is the source of Honey/ Nectar store and Pollen areas. Honey bee colonies build their strength by collecting pollen from *Brassica campestris* (toria and sarson), stone and pome fruits etc. *Plectranthus*, *Fagopyrum sagittatum*, *Thymus serpyllum*, *Prunus puddum*, *Toona ciliata*, *Ehretia* and *Dalbergia sisoo* etc which are important honey sources in the state. Beekeepers are finding difficulties in obtaining required and standard equipment in the state. They are also facing difficulties at check posts: barriers while migration of colonies to other states. Survey studies revealed that beekeepers of Himachal Pradesh are aware about the different management practices against various diseases, mites and enemies of *A. mellifera* but still there is need to impart scientific knowledge for profitable beekeeping.

5. Recommendations

Following recommendations are being made to develop beekeeping industry in the districts of Himachal Pradesh:-

- Queens rearing techniques should be familiarize.
- Satisfactory supplementary feed/sugar syrup should be provided to bee colonies during inadequacy period and pollen substitute should be given at appropriately.
- Excessive use of pesticides, weedicides, and fungicides should be avoided. Pesticides should be used in very optimum concentration.
- Diversification of crops is urgently required, so that period of floral paucity may be dwindling.
- Regular inspection of apiary should be carried out to check swarming & absconding etc. Apiary area must be kept hygienic. There should be proper spacing between the colonies.
- Provision of extracting various hive products other than honey like royal jelly, propolis, bee venom and pollen must be done to make the beekeeping more profitable.
- Population of colonies must be kept strong as weak colonies can be attacked by various diseases and enemies like wax moth etc. Proper management techniques should be followed.
- Government should pay more attention towards formulation of policies related to development & marketing of hive products.

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