



ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; SP-10(12): 932-937
© 2021 TPI

www.thepharmajournal.com

Received: 16-10-2021

Accepted: 18-11-2021

Naveen

Department of Entomology,
College of Agriculture, Gwalior,
Rajmata Vijayaraje Scindia
Krishi Vishwa Vidyalaya,
Gwalior, Madhya Pradesh, India

Ashok Singh Yadav

RVSKVV- Krishi Vigyan
Kendra, Morena, Madhya
Pradesh, India

Sakshi Saxena

Department of Entomology,
College of Agriculture, Indore,
Rajmata Vijayaraje Scindia
Krishi Vishwa Vidyalaya,
Gwalior, Madhya Pradesh, India

Shivani Suman

Department of Entomology,
College of Agriculture, Indore,
Rajmata Vijayaraje Scindia
Krishi Vishwa Vidyalaya,
Gwalior, Madhya Pradesh, India

Neeraj Kumar

Department of Entomology,
College of Agriculture, Gwalior,
Rajmata Vijayaraje Scindia
Krishi Vishwa Vidyalaya,
Gwalior, Madhya Pradesh, India

Nishikant Yadav

Department of Entomology,
College of Agriculture, Indore,
Rajmata Vijayaraje Scindia
Krishi Vishwa Vidyalaya,
Gwalior, Madhya Pradesh, India

Corresponding Author

Naveen

Department of Entomology,
College of Agriculture, Gwalior,
Rajmata Vijayaraje Scindia
Krishi Vishwa Vidyalaya,
Gwalior, Madhya Pradesh, India

Survey studies on the status of beekeeping in the Chambal region of Madhya Pradesh

Naveen, Ashok Singh Yadav, Sakshi Saxena, Shivani Suman, Neeraj Kumar and Nishikant Yadav

Abstract

Survey studies were carried out at different locations nearby the Chambal region of Morena district during April, 2019 to March, 2020 and the information was collected from beekeepers of Mirghan, Matkora, Ancholi, Dhurkuda, Bastoli, Koda, Ganjrapur, Nayagaon villages of the region about different aspects of beekeeping such as bee flora, practices adopted, and awareness about incidence, management of diseases and enemies and their own experience about the apiculture. The incidence of EFB disease was observed from September to November 2019 in Mirghan, Bastoli and Dhurkuda villages and in some parts of Matkora and Ancholi villages during July and February 2020. *Varroa* Mite infestation was observed by the beekeepers of Nayagaon village in September and in July 2019 and February 2020 in Matkora and Bastoli villages, respectively. *Tropilaelaps clareae* mite incidence was observed negligible in the region during the study period. Larvae and pupa of greater wax moth were the most destructive stages. These were observed in Mirghan, Matkora, Ancholi, Konda, Ganjrapur and Nayagaon villages of the region during August to November 2019 causing considerable losses to bee colonies. Apart from diseases and pests, wasp was reported to cause nuisance to bee colonies during July to October 2019 by the beekeepers of Mirghan, Matkora and Konda villages and during February 2020 in Nayagaon village. Ant attack was observed in the bee colonies during August to October 2019 by beekeepers of Konda, Nayagaon, Matkora, Bastoli and Mirghan villages. Bee eaters also caused nuisance to colonies during July to October 2019 in Ganjrapur, Bastoli and Mirghan villages and during February 2020 in Matkora village of Chambal region. Beekeepers are using terramycin and 1% soap & formalin solution for management of European foulbrood disease in Mirghan, Dhurkuda and Bastoli villages. Beekeepers from Nayagaon village are using Sulphur, Mite strips and veticol for management of *Varroa* Mites. For wasps, destruction of wasp nests, honey baits mixed with different insecticides and different types of traps were adopted. Dusting of Fenvalerate around colony box is done for management of Ants in Nayagaon, Matkora, Mirghan and Bastoli villages. Proper Hygiene, protection and care is being taken for effective management of honeybee colonies.

Keywords: diseases, pests, management, *Apis mellifera* L., Chambal region, wasp, ants, bee-eater birds

1. Introduction

The beekeeping with European honey bee, *A. mellifera* L. is practiced in the region both under stationary and migratory conditions. At present, there are approximately 4500-5000 beekeepers in the region currently having 55,000-60,000 colonies (*Apis mellifera* L.) that yields approximately 5,124 tons of honey (KVK Morena, 2017), leading Morena district at the top in Madhya Pradesh for honey production. The cropping system of the Chambal region provides abundant flora for honey bees therefore, this zone of Madhya Pradesh is a paradise for beekeepers not only for the state but also for neighboring states such as Rajasthan and Uttar Pradesh, thus has an enormous potential for profitable beekeeping. It has tremendous back up of bee flora from field crops also as from horticultural crops. Therefore, commercial bee keeping is very popular in this area from October to April. Presently beekeeping industry is facing many challenges throughout the world. Among these, a major constraint in beekeeping developmental programs is the depredation of a large number of diseases and enemies. Honey bees are attacked by many diseases and insect pests, which cause weakness of colonies and ultimately low honey production. These enemies include diseases, insect pests, wasps, ants, *Apis dorsata*, bee-eater birds, etc. Of all these enemies, some feed on honey, some on wax and rest on brood and adult bees. All these diseases, insect pests and other enemies causes moderate to severe damage to honey bee colonies and the same constraints are faced by beekeepers of the region which impairs the health and normal working of honey bees. European foulbrood is very common all over the world, where *Apis mellifera* L. exists

(White, 1912). In India, this disease was recorded for the first time in *A. cerana* from Maharashtra during 1970 (Diwan *et al.*, 1971). 2.52 to 2.92 per cent mortality of brood was reported first time in India in *A. mellifera* colonies during 1998 (Chandel *et al.*, 1999)^[8] due to sac brood. Varroa mite parasitizing the *A. mellifera* is responsible for loss of more than 50% colonies worldwide (Shaw *et al.*, 2002; Topolska *et al.*, 2010; Martin *et al.*, 2012; Nazzi *et al.*, 2012)^[18, 23, 15, 16]. 90 per cent apiaries and 50 per cent colonies of state of Haryana are affected by this mite (Gulati *et al.*, 2009)^[12]. The incidence of *T. clareae* was noticed throughout the year in colonies of *A. mellifera* in Punjab with peak infestation during March-April and October-November (Gatoria *et al.*, 1995)^[11]. In India, greater wax moth was observed throughout the years in both higher and lower altitudes, but peak infestation was recorded during May to September. However, (Brar *et al.*, 1985)^[7] recorded 16 to 19 per cent infestation in *A. mellifera* colonies in north India. Rana *et al.* (2000)^[17] reported peak predatory wasp activity from August to November in Himachal Pradesh (av. 208-252 wasps/ day) whereas it was July to September in Jammu (av. 13.5 wasps/ day) (Abrol and Kakroo, 1998)^[2].

So, it is of prime importance that beekeepers should be aware of these potential damaging factors and can well protect their honey bee colonies to get the maximum benefit from beekeeping venture. Despite the fact, only few attempts have been made. Hence, there was a need for qualitative study and survey of insect pests, pathogens, predators and other enemies of *A. mellifera* L. with the changing scenario of environmental conditions, and this survey study was conducted to provide comprehensive research information on their occurrence which may immensely be helpful for beekeepers to take care of their honeybee colonies.

2. Material and Methods

The survey study was conducted in different locations and villages nearby the Chambal region during April, 2019 to March, 2020. Information on various parameters and practices followed for *Apis mellifera* L. rearing *viz.*, enemies, awareness and management practices adopted by beekeepers for maintenance of bee colonies, honey storage practices, migratory route followed by the beekeepers and their own experience about the apiculture was gathered and compiled. For this survey, a structured questionnaire was prepared and administered to collect information from beekeepers of Mirghan, Matkora, Ancholi, Dhurkuda, Bastoli, Koda, Ganjampur, Nayagaon villages of the Chambal region of Madhya Pradesh. General information about themselves, family, address, location of apiary, number of active colonies, availability of bee flora, honey flow sources, route and duration of migration, their experience about beekeeping venture and constraints faced by them. The data on different enemies of *A. mellifera* L. experienced and observed by beekeepers was recorded and average colony loss was calculated. Information about Name of disease, pest and other enemies experienced by the beekeeper, period of incidence of enemies, loss of colonies due to enemy attack etc. and management practices adopted by a beekeeper for various enemies was gathered.

3. Results and Discussion

3.1 General information

The survey conducted across different villages of Chambal region revealed that beekeepers maintains 40-500 colonies of

A. mellifera as stationary and migratory beekeeping. They used to migrate their colonies from Morena to different floral belts of Madhya Pradesh and nearby districts of Uttar Pradesh and Rajasthan during the periods of dearth. This region of Madhya Pradesh holds an important position in copious honey production in India. Morena District tops the state in production of honey.

Majority of the bee keepers trained under various training programs on regular basis through KVK, Morena now works as master trainers at other private organizations to promote bee keeping venture. With all this knowledge, beekeepers adopts modern package of practices and techniques for beekeeping. Since the average land holding per person in this area is quite low, even many people being landless, they were totally dependent on beekeeping for their livelihood. Hence, apiculture has formed a major source of employment for them. Herewith the honey production, queen rearing and multiplication of honeybee colonies is being commonly practiced in the study area.

Taking into consideration the improvement in selling and marketing of honey and other beekeeping related products, beekeepers gets facilitates by KVK, Morena through Self Help Groups (SHGs). For purification, packaging and quality testing facility, beekeepers are connected with honey processing and packaging plant and a quality testing laboratory established at KVK.

3.2 Floral sources and Migratory cycle

The sources of bee flora for surplus honey production varies in the region as shown in the Table 1. Important sources of bee flora reported by beekeepers of the region includes sesame, green gram, black gram, pearl millet, medium duration pigeon pea and Celery (Ajwain) during July to October at, Coriander, rape seed and mustard during November to February and Berseem during mid-March to mid-May. Rapeseed and mustard flora provides abundant nectar and pollen which mainly helps in the strong build-up of colonies. During the rest of the year, the flora of forest plants such as adusa (*Adhatoda vasica*), kher (*Acacia catechu*), drum-stick (*Moringa oleifera*), shisham (*Dalbergia sissoo*), and neem (*Azadirachta indica*) are available in abundance. The major bee flora sources reported by beekeepers during the survey were mentioned as major honey flow sources in the Report of the Beekeeping Development Committee conducted by EAC-PM, GoI, June 2019 and other previous studies (Tomar, *et al.*, 2014; Yadav *et al.*, 2014)^[22, 26].

According to the survey studies, beekeepers of Chambal region are following different migratory cycles (Table 2) for *A. mellifera*: 1) Mid November to Mid-February: Rapeseed and mustard as major honey source in Morena, Bhind, Sheopur and small parts of Shivpuri district of Madhya Pradesh and Dholpur and Bharatpur districts of Rajasthan. 2) Mid-February to March: Coriander as a major honey source in Ashoknagar and Guna districts of Madhya Pradesh. 3) April to Mid-May: Berseem as a major honey source in Morena, Dabra block of Gwalior and Sheopur districts of Madhya Pradesh. 4) June to July: Pearl millet as a major honey source in Morena, Bhind and Sheopur districts of Madhya Pradesh and during August- September to Etawah, Hathras and Aligarh districts of Uttar Pradesh. Throughout the summer months, some beekeepers also prefers to migrate their colonies for Kher, Babool and other forest flora to Bhatেশwar and nearby forest belt of Rajasthan. 5) October- November: Pigeon pea as a major honey source to Morena, Sheopur and parts of Bhind

of Madhya Pradesh. For celery (Ajwain) to Shivpuri districts of Madhya Pradesh.

3.3 Incidence of diseases and management practices in *A. mellifera*

The information collected from beekeepers on the incidence of diseases and insect pests in honey bee colonies along with their period of incidence, annual colony loss and management adopted by beekeepers (Tables 3) revealed that incidence of European Foulbrood is commonly observed and Sac brood is occasionally observed in the region. The incidence of EFB disease was observed from September to November 2019 in Mirghan, Bastoli and Dhurkuda villages, when there is scarcity of floral sources in the region. It was also observed in some parts of Matkora and Ancholi villages during July and February 2020. Incidence of this disease is due to the lack of floral sources and weak colony strength. Abrol and Ball (2006) [3] conducted a survey in different apiaries of Jammu during 2003-2004 and reported that 10-15 per cent colonies suffered from European foulbrood disease. The symptoms of the disease included sudden weakening of the colonies. The disease was noticed during dearth period and high infestation was noticed.

Mites such as *Varroa destructor* and *Tropilaelaps clareae* also causes considerable damage to bee colonies. *Varroa* Mite infestation was observed by the beekeepers of Nayagaon village in September. It was also observed in July 2019 and February, 2020 in Matkora and Bastoli villages of the Chambal region, respectively. *T. clareae* mite incidence was observed negligible in the region during the study period. This mite attack is due to the change in weather parameters such as temperature and relative humidity.

Greater Wax moth is also an important insect pest of honeybees which in the condition of severe infestation, can destroy the entire combs/ colonies and abscond the bees within 2-3 days. Larvae and pupa of greater wax moth are the most destructive stages. It was observed in Mirghan, Matkora, Ancholi, Konda, Ganjrampur and Nayagaon villages of the region during August to November 2019 causing considerable losses to bee colonies. Severe infestation occurs due to many reasons such as inactivity of honeybees, continuous bad and cloudy weather conditions, weak colony strength, lack of floral sources, and improper hygiene of beehive.

Beekeepers are applying different chemicals, adopting various traditional and modern practices for management of diseases, insect pests and other enemies in *A. mellifera* (Table 4). Terramycin and 1% soap & formalin solution are used for management of European foulbrood disease in Mirghan, Dhurkuda and Bastoli villages. Beekeepers from Nayagaon village are using Sulphur, Mite strips and veticol for management of *Varroa* Mites in *A. mellifera* colonies. Regular monitoring of honeybee colonies aids much in the successful management and controlling of most of the diseases, insect pests and other enemies. Several mites and pest infestations and microbial, bacterial and viral infections cause severe loss to the colonies. Sulphur dusting, formic acid fumigation etc. is effective against mites Gupta (1988) [13].

3.4 Incidence of enemies and management practices in *A. mellifera*

Apart from diseases and insect pests, attack of other enemies such as Wasps, Ants, Bee-eater Bird and Giant honeybees (Table 4) also causes damage to *A. mellifera* L. colonies and destroys the comb hives rapidly. Wasp was reported to cause nuisance to bee colonies during July to October 2019 by the beekeepers of Mirghan, Matkora and Konda villages and during February 2020 in Nayagaon village. Ant attack was observed in the bee colonies during August to October 2019 by beekeepers of Konda, Nayagaon, Matkora, Bastoli and Mirghan villages. Bee eaters also caused nuisance to colonies during July to October 2019 in Ganjrampur, Bastoli and Mirghan villages and during February 2020 in Matkora village of Chambal region. These enemies mostly visits in the morning hours and attacks colonies mostly due to continuous bad/ cloudy/ stormy weather. Birds are also very important threat to bee colonies (Brar 2016) [6]. Blue bee-eater (*Nyctyornis aethertoni*) can eat average 270 bees per 13.5 minute, and incidence of bird was reported in February month in Nauni, Solan.

For the management of wasps, destruction of wasp nests (Bhutani, 1950 and Singh, 1962) [5, 20], honey baits mixed with different insecticides (Wafa *et al.*, 1969 and Aihara, 1980) [24, 4], and usage of different types of traps (Hussein, 1989; Shoreit, 1998 and Abou ElEnain, 1999) [14, 19, 1] are the methods adopted by beekeepers. Dusting of Fenvalerate around colony box is done for management of Ants in Nayagaon, Matkora, Mirghan and Bastoli villages. Proper Hygiene, protection and care has been taken for effective management of honeybee colonies. The important insect pests like Greater Wax Moth and other enemies like Ants were observed by beekeepers have also been discussed while describing weather effect on incidence of pests of Honeybee (*Apis mellifera*) in Gird zone of Madhya Pradesh (Singh, *et al.*, 2009) [21].

The information collected from beekeepers of Chambal region shows that they are aware about the important bee flora sources, diseases, insect pests, other enemies and their effective management practices. No such survey was conducted in the region earlier.

3.5 Seasonal management practices adopted by beekeepers for the *A. mellifera* apiary

Checking the queen health is observed in autumn season and if required, a young and healthy queen is developed and replaced with the old queen in the colony. Winter packaging to withstand harsh conditions of weather is sometimes done during very low temperature conditions and artificial feeding is done when needed. During the summer months, the colonies are placed in shady conditions, water needs are checked regularly and honey is extracted. Colonies are maintained at dry places and regular checking of colonies for diseases and pest infestation during heavy rainy days in monsoon season. In summer months, the winter packaging of colonies is removed as the temperature is increased and artificial feeding is done to sustain the colony strength.

Table 1: Important bee flora of different locations of the Chambal region.

Sr. No.	Common Name**	Scientific Name	Family	Region
1	Sesame*	<i>Sesamum indicum</i>	Pedaliaceae	Morena, Sheopur and Bhind
2	Green gram	<i>Vigna radiate</i>	Leguminosae	Morena, Sheopur and Bhind
3	Black gram	<i>Vigna mungo</i>	Leguminosae	Morena, Sheopur and Bhind
4	Pearl millet*	<i>Pennisetum glaucum</i>	Poaceae	Morena, Sheopur, Bhind, Shivpuri, Hathras, Aligarh, Sikar
5	Pigeon pea*	<i>Cajanas cajan</i>	Leguminosae	
6	Celery (Ajwain)*	<i>Apium graveolens</i>	Apiaceae	Shivpuri
7	Sorghum	<i>Sorghum bicolor</i>	Poaceae	Sheopur and Morena
8	Rapeseed*	<i>Brassica</i> spp.	Brassicaceae	Morena, Sheopur, Bhind, Shivpuri, Dholpur and Bharatpur
9	Mustard*			
10	Fenugreek*	<i>Trigonella foenum graecum</i>	Leguminosae	Ashok Nagar and Guna
11	Coriander*	<i>Coriandrum sativum</i>	Umbellifereae	
12	Gram	<i>Cicer arietinum</i>	Leguminosae	Morena, Sheopur, Bhind, Shivpuri, Guna and Ashok Nagar
13	Okra	<i>Abelmoscus esculentus</i>	Malvaceae	Sheopur, Shivpuri and Morena
14	Garlic	<i>Allium sativum</i>	Amaryllidaceae	
15	Onion*	<i>Allium cepa</i>	Alliaceae	
16	Berseem*	<i>Trifolium alexandrinum</i>	Leguminosae	Morena, Gwalior and Sheopur
17	Citrus*	<i>Citrus</i> spp.	Rutaceae	Morena, Sheopur, Bhind, Shivpuri, Guna and Ashok Nagar
18	Papaya	<i>Carica papaya</i>	Caricaceae	
19	Pea	<i>Pisum sativum</i>	Leguminosae	Morena, Sheopur, Bhind, Shivpuri, Guna, Ashok Nagar, Bhatেশwar and nearby forest belt.
20	Adusa	<i>Adhatoda vasica</i>	Acanthaceae	
21	Kher	<i>Acacia catechu</i>	Leguminosae	
22	Drum stick*	<i>Moringa oleifera</i>	Moringaceae	
23	Shisham*	<i>Dalbergia sissoo</i>	Fabaceae	
24	Neem*	<i>Azadirachta indica</i>	Meliaceae	
25	Eucalyptus*	<i>Eucalyptus</i> spp.	Myrtaceae	
26	Ber*	<i>Ziziphus mauritiana</i>	Rhamnaceae	
27	Mehandi	<i>Lawsonia inermis</i>	Lythraceae	
28	Babool	<i>Vachellia nilotica</i>	Fabaceae	
29	Gulmohar	<i>Delonix regia</i>	Fabaceae	
30	Madhu Kamini	<i>Murraya paniculata</i>	Rutaceae	

*Major honey flow sources, **as per information provided by beekeepers during survey.

Table 2: Migratory route followed by the beekeepers of the region throughout year.

Sr. No.	Period	Major Honey Source	District	State
1.	Mid Nov.- Mid Feb.	Rapeseed and Mustard	Morena, Bhind, Sheopur and small part of Shivpuri	Madhya Pradesh
			Dholpur and Bharatpur	Rajasthan
2.	Mid Feb.- March	Coriander	Ashoknagar and Guna	Madhya Pradesh
3.	April-Mid May	Berseem	Morena, Dabra block or Gwalior and Sheopur	Madhya Pradesh
4.	June-July	Pearl millet	Morena, Bhind, Sheopur	Madhya Pradesh
	Aug- Sept		Etwah, Hathras and Aligarh	Uttar Pradesh
	Summer Month		Sikar and Alwar	Rajasthan
5.	Oct- Nov	Pigeon Pea	Morena and parts of Bhind and Sheopur	Madhya Pradesh
		Celery (Ajwain)	Shivpuri	Madhya Pradesh

Table 3: Incidence of diseases and pests of *Apis mellifera* L. experienced by beekeepers of the Chambal region

Bee diseases/ pests	Name of Area/ Village	Months of prevalence	Annual Colony Loss (%)	Management by Beekeepers
European Foulbrood	Mirghan	September-October	16.00	<ul style="list-style-type: none"> Sugar solution (50%). Remove and destroy the infested frames and colonies. Treat the infested frames by dipping the frames in 1% Soap and 1% Formalin solution. Dusting of Terramycin 250mg on the infected brood after extraction of honey. Antibiotics (only after extraction of honey).
	Matkora	June-July	10.00	
	Ancholi	February-March	12.00	
	Dhurkuda	October-November	17.00	
	Bastoli	September-October	15.00	
Varroa mite	Konda	June-July	11.00	<ul style="list-style-type: none"> Cage the queen for 21 days to stop the disease cycle. Can be physically removed by sugar dusting method. Fumigate Formic acid 85% @ 5 ml inside the box. Smoke fumigation by using sulphur. Burn and smoke the thick paper treated with 30% Potassium Nitrate solution. Use of mite strips @ 1-2 strips/ box and veticol @ 2-3 drops/ box.
	Nayagaon	September-October	16.00	
	Matkora	June-July	10.00	
Greater Wax Moth	Bastoli	February-March	13.00	<ul style="list-style-type: none"> Proper storage of empty boxes and frames.
	Mirghan	August-September	19.00	
	Matkora	August-September	22.00	

	Ancholi	September-November	16.00	<ul style="list-style-type: none"> Remove old combs during times of food scarcity when colony size shrinks. Use of formic acid in winters to induce bees' activity. Fumigation by- Sulphur, Ethylene dibromide, Paradachlorobenzene, celphos during storage of empty frames. Destroy infested frames and boxes. Seal all the holes and cracks inside the hive box. Scrape away any eggs, wax moth faeces and pupa of wax moth and expose the empty frames and boxes to the sunlight. Cleaning the boxes at the fortnightly intervals, and free from dust and debris. Always use clean wax on the starter strips.
	Konda	September-October	16.00	
	Ganjrapur	October-November	15.00	
	Nayagaon	August-September	19.00	

Table 4: Status of enemies and management practices in *A. mellifera* adopted by beekeepers

Sr. no.	Enemies	Causal organism	Name of Area/ Village	Period of incidence (Month)	Annual Colony Loss (%)	Management by Beekeepers
1.	Wasp	<i>Vespa</i> spp.	Mirghan	September-October	8.00	<ul style="list-style-type: none"> Killing the wasp queen at the early times of their occurrence. Destroy all the nests/ colonies of wasps within 2 km from the apiary site. Entrance of the hive should be small. Use Wasp trap for effective control of wasps.
			Matkora	July-August	4.00	
			Konda	August-September	9.00	
			Nayagaon	September-October	6.00	
2.	Ants	<i>Lasius niger</i>	Konda	September-October	8.00	<ul style="list-style-type: none"> Dig and destroy the ant hill. Put legs of hive stand inside the water filled in plastic cups. Dusting of Fenvalerate 0.4% DP.
			Nayagaon	September-October	9.00	
			Matkora	August-September	10.00	
			Bastoli	August-September	7.00	
			Mirghan	August-September	9.00	
3.	Other enemies	<i>Apis dorsata</i> L. Bee-eater Birds	Ganjrapur	July-August	4.00	<ul style="list-style-type: none"> Don't leave any brood combs exposed to Bee-eaters. Scarecrows scaring the birds, including various sound-producing devices Scaring the birds by drum beating and stone pelting loud noises
			Matkora	February-March	9.00	
			Bastoli	August-September	8.00	
			Mirghan	September-October	9.00	



Plate 1: Survey studies on the status of beekeepers apiary at Mirghan, Matkora and Ancholi villages in Chambal region of Madhya Pradesh.

4. Conclusion

Beekeeping with *Apis mellifera* L. species in Chambal region is profitable under stationary as well as migratory conditions, since colonies gained strength and produced surplus honey. These were also divided when migrated to floral belts. Beekeepers of the study region were aware about the modern techniques of beekeeping. The incidence of various diseases, pests and other enemies was moderate. Beekeepers reported considerable loss due to diseases, insect pests and other enemies in *A. mellifera* colonies. According to them, the annual colony loss percentage caused due to all diseases, insect pests and other enemies was invariably varied from 4 per cent to 22 per cent. Many of them are using scientific techniques of beekeeping and their management. They have adequate knowledge of availability of natural floral sources and have detailed knowledge about migratory routes to be followed during the dearth periods. Beekeepers adopts

modern package of practices and techniques for beekeeping. Since the average land holding per person in this area is quite low, even many people being landless, they were totally dependent on beekeeping for their livelihood. Hence, apiculture formed a major source of employment for them. Herewith the honey production, queen rearing and multiplication of honeybee colonies is being commonly practiced in the study area. Beekeepers of this region are adopting safer and effective methods for management of diseases, insect pests and other enemies. These studies suggested that though beekeepers are aware about important beekeeping practices but still there is need to impart scientific knowledge for profitable beekeeping.

5. Acknowledgement

The authors acknowledge the support from the Department of Entomology, College of Agriculture, Gwalior, Associate

Director Research, ZARS, Morena and Senior Scientist & Head, Krishi Vigyan Kendra, Morena for providing necessary facilities to carry out this survey study.

6. References

1. Abou El-Enain HT. Studies on *Vespa orientalis* Fab. attacking honeybee colonies and its control by modified traps. *Egypt Journal of Applied Sciences* 1999;14(12):685-696.
2. Abrol DP, Karroo SK. Studies on seasonal activity and control of predatory wasps attacking honeybee colonies. *Indian bee Journal* 1998;60(1):15-19.
3. Abrol DP, Ball BV. New record of European foulbrood (EFB): a bacterial disease of honey bee *Apis mellifera* L. in Jammu, India. *Journal of Research* 2006;5:256-60.
4. Aihara S. Control of giant hornets by mixture of honey and agrichemical. *Honeybee Science* 1980;1:23-24.
5. Bhutani DK. The wasp menace. *Indian Bee Journal* 1950;12:129-130.
6. Brar AS. Seasonal Incidence of Diseases and Enemies in *Apis mellifera* L. M.Sc. Thesis. Department of Entomology, Dr. YS Parmar University of Horticulture and Forestry, Solan 2016, 51.
7. Brar HS, Gatoria GS, Jhajj HS, Chahal BS. Seasonal infestation of *Galleria mellonella* and population of *Vespa orientalis* in *Apis mellifera* apiaries in Punjab. *Indian Journal of Ecology* 1985;129:735-737.
8. Chandel YS, Kumar A, Ball BV. Sacbrood disease in Italian honey bee, *Apis mellifera* L., in Himachal Pradesh, India. *Pest Management and Economical Zoology* 1999;7:181-182.
9. Diwan VV, Kshirsagar KK, Raman RAV, Raghunath D, Bhambure CS, Godbole SH. Occurrence of new bacterial disease of Indian honey bee (*Apis indica* F.). *Current Science* 1971;40:196-197.
10. Economic Advisory Council to Prime Minister (Govt. of India), Report of the Beekeeping Development Committee. 2019, 24.
11. Gatoria GS, Brar HS, Jhajj HS. Seasonal incidence of ectoparasitic mite, *Tropilaelaps clareae* Delfiando and Baker and its control in *Apis mellifera* colonies. *Journal of Insect Science* 1995;8:157-159.
12. Gulati R, Sharma SK, Saini RK. Varroa, enemy of honeybees: its effect, life cycle and control. *Tech. Bull., Deptt. of Entomology, CCS HAU, Hisar* 2009, 24.
13. Gupta M. Insecticides and Bee Poisoning. *Indian Bee Journal*. 1988;50:42-43.
14. Hussein MH. Studies on some pests of honeybee colonies in Dhofar, Oman. *Proc. 4th International Conference Apiculture Tropical Climates, Cairo* 1989, 370-376.
15. Martin SJ, Highfield AC, Brettell L, Villalobos EM, Budge GC, Powell M *et al.* Global honey bee viral landscape altered by a parasitic mite. *Science* 2012;336:1304-1306.
16. Nazzi F, Brown SP, Annoscia D, Del Piccolo F, Di Prisco G, Varricchio P *et al.* Synergistic parasite-pathogen interactions mediated by host immunity can drive the collapse of honey bee colonies. *PLoS Pathogens* 2012;8(6):1-16.
17. Rana BS, Kumar A, Gupta JK. Influence of environment factors on the population of predatory wasps of honeybees and evaluation of methods for controlling the wasps. *Indian Bee Journal* 2000;62:47-54.
18. Shaw KE, Davidson G, Clark SJ, Ball BV, Pell JK, Chandler D, *et al.* Laboratory bioassays to assess the pathogenicity of mitosporic fungi to *Varroa destructor* (Acari: Mesostigmata), an ectoparasitic mite of the honeybee, *Apis mellifera*. *Biological Control* 2002;24(3):266-276.
19. Shoreit MN. Field observations on the seasonal abundance and control of *Vespa orientalis* Fab. Attacking honeybee colonies in Egypt. *Journal Applied Sciences* 1998;13(4):250-256.
20. Singh S. Beekeeping in India. ICAR, New Delhi 1962, pp. 209
21. Singh S, Verma R, Chaturvedi SK. Weather effect on the incidence of pests of honeybee (*Apis mellifera*) in Gird zone of Madhya Pradesh. *Journal of agrometeorology* 2009;SP11:160-164.
22. Tomar SPS, Singh YP. Effect of Sugar solution feeding as an artificial diet on colonies of *Apis mellifera* L. In relation to survival and storage during Dearth period. *Journal of Entomology and Zoology Studies* 2014;2(4):265-267.
23. Topolska G, Gajda A, Pohorecka K, Bober A, Kasprzak S, Skubida M, *et al.* Winter colony losses in Poland. *Journal Apiculture Research* 2010;49:126-128.
24. Wafa AK, El-Borolossy FM, Charkawi SG. Control work of *Vespa orientalis* F. *Bulletin of Entomological Society Egypt, Economics Services* 1969;3:9-16.
25. White GF. The cause of European foul brood (No. 157). US Government Printing Office 1912.
26. Yadav AS, Singh YP. Bee keeping in Chambal region of Madhya Pradesh. *Agricultural Extension in South Asia-Good Practices-6*, 2014.