

BIODIVERSITY OF WINTER PLANTS AS BEE FORAGE IN CHANDIGARH AREA

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ABSTRACT

The present investigations pertain to the bee forage plants in Chandigarh during winter months. Winter is season during which most of the areas has shortage of bee forage plants. Chandigarh is the city which is well known for its greenery and tree plantation pattern. This is an attempt to know the potential of Chandigarh plants as bee forage plants during winter months. Area under observation has been divided into five sub- divisions. Visual observations were done to analyze the bee forage plants in each sub- division. Percentage of honey bees visit on each plant was calculated out of total number of insects visited the plant. These calculations and observations highlight the potentiality of plants which are greatly preferred by honey bees. We have observed various plants in Chandigarh area which bloom during winter. These plants can help beekeepers to maintain small apiaries in these areas during winter months instead of shifting their small apiaries to distant places. All these observations will also provide demystified knowledge for those who wish to increase their income by doing beekeeping in particular season.

Keywords: Winter, bee forage, apiaries, income, beekeeping.

INTRODUCTION

Honey bees are very important pollinators as it pollinate almost 80% of the world's agricultural crops (Calderone, 2012). Relation between pollination and honey bees reveals that flowering plants and honey bees have evolved together. They have strong relation among flower shape, flower preference by honey bees and also foraging frequency by honey bees on particular flowers.

Flowering plants produce pollen and nectar as food to honey bees while honey bees help in pollination by transferring pollen grains from one flower to another flower. Pollen grains are sole source of protein in the hive for brood rearing and colony development (Carpes *et al*, 2009). Nectar is main source of energy for the colony. Pollen contains various types of nutrients but their nutrient quality and quantity depends on the weather conditions, geographical conditions and also type of plants from which pollen has been collected (Abou- Shaara, 2014). Different plant habitats and environmental conditions also affect the flowering seasons in different areas (Tilahun, 2003, Amha, 2003). Availability of enough sources of pollen and nectar near apiaries is very essential for proper growth of the hives. Good health of hives and enough bee forage near hives reflects the better production of hive products like honey and bee pollen.

Bee forage can better be understood by visual observation of bees on plants during foraging hours. Various factors like time, distance, flower preference and various in- colony factors may affect the foraging behavior of honey bees, *Apis mellifera* (Abou- Shaara, 2014).

Knowledge about bee forage plants in particular area in each season is very important for bee keeping industry to obtain associated benefits like honey, wax and pollination. Floral calendar of floral resources of various areas has been prepared at national and international level. Kumari, 2004 prepared floral calendar of bee forage plants of Visakhapatnam, Andhra Pradesh. Chaturvedi (1973) analyzed the botanical composition of bee loads from Banthra, Lucknow in relation to seasonal preferences. 15 families and 18 taxa of both entomophilous and anemophilous angiosperms have been found in Bhimtal during autumn season by melittopalynological study of honey bee pollen (Garg, 1996).

The present study is an attempt to gather the information about bee forage sources in Chandigarh during winter season.

MATERIAL AND METHODS:

The observations were made in different areas of Chandigarh in particular season.

Study area: Plants were studied in five sub- divisions of Chandigarh as per layout given by Municipal Corporation, Chandigarh. Apiaries were installed and maintained in each sub – division. The details of five sub- divisions which were prepared by Municipal Corporation, Chandigarh follows as:

Table 1: Showing details of sub- divisions of Chandigarh.

Sub-division 1	SECTOR- 25, 36, 37, 38, 38(WEST), 39, 40, 41, 42, Attawa, Buterla, Dhanas, Dadumajra, Maloya Colony, Janta Colony.
Sub-division 2	SECTOR- 27, 28, 30, 31, 32, Sec 29 Industrial area phase 1, Sanjay Colony(SLUM), Industrial area phase 1 and Industrial area (phase 1 Colony no. 4), Industrial area and phase II Entire and Karson Colony, Hallomajra, Bair-majra.
Sub-division 3	SECTOR- 1 to 11, 12, 14, 15, 16, 17, 18, 19, 21, 22, 23, 24 and Khuda Lahora.
Sub-division 4	SECTOR- 26, Bapudhamtragt Camp II Phase II Sec- 26E, Transport area Sec- 26-E, EWS Housing Board, Bapudhamtragt Camp I Phase I, Bapudhamtragt Camp III Phase III and Madarsi Colony (HUTS), Mouli Complex (Railway Colony), AmbedkarAvasYojna, Mouli Complex (Charan Singh Colony), Bhagat Singh Colony, Vikas Nagar, Shivalik Enclave and Mouli Complex (Housing Board), Old Manimajra (NAC), Shanti Nagar, Mai Wala Town, Thakur Dwara, Chandigarh Housing Complex, MohallaGovindpura, Dhillo Complex, Motor Market pocket no. 8, DarshaniBagh, Subhash Nagar, Adarsh Nagar, PipliWala Town, Gawala Colony, Indira Colony (Reh.), Old Indira Colony Race Course and I.T. park.
Sub-division 5	SECTOR- 20, 33, 34, 35, 43, 44, 49, 50, 51, 52 (NizamPurBurail), 51, Brick- Killin, NizampurKumbra, Sub jail, NimpurKumbra and Sec- 55, 56, 60, 61, 63, Sec-45 and Burail, Faiden-Burail and Char- Taraf- Burail.

Study time: Study period involved the winter season which included the months from November end to February end in 2017. Observations were done thrice a day i.e. morning: 700-800 hrs, afternoon: 1300-1400 hrs, evening: 1700-1800 hrs.

Foraging frequency of honey bees on each plant: It is observed by calculating the percentage (%) of honey bees on each plant which is determined by collecting insects on plants using sweep net method then calculating the percentage of presence honey bees in total collection of insects.

Percentage of honey bees in total collection of insects: $\frac{\text{Number of honey bees in collection}}{\text{Total number of insects collected}} \times 100$

Number of flowers visited by honey bee in one minute was calculated by using mobile stop watch. Some flowers were present in greater number while others were in lesser number. So, during one minute many flowers were revisited.

Time spend by honey bee on flower of each plant is also very important factor to know their potentiality.

RESULTS AND DISCUSSION:

In field survey, 20 types of plants were studied as bee forage plants which were commonly present in Chandigarh area. Presence of each plant varies in each sub- division. Few sub- divisions have greater number of some plants and lesser or absence of other plants.

Table 1: Presence (*) or absence (-) of plants in each sub-division.

S.no.	Plants present commonly as bee forage	Sub-division 1	Sub-division 2	Sub-division 3	Sub-division 4	Sub-division 5
1	<i>Chrysanthemum sp.</i>	*	*	*	*	*
2	<i>Rosa india</i>	-	*	*	*	-
3	<i>Brassica campestris</i>	-	*	*	-	*
4	<i>Eucalyptus sp.</i>	*	-	*	*	-
5	<i>Calendula officinalis</i>	*	*	*	*	*
6	<i>Coleus sp.</i>	*	-	*	-	*
7	<i>Bauhiniriablackiana</i> (Pink Kachnar)	*	-	*	-	-
8	<i>Bauhiniria variegata</i>	*	*	*	-	*
9	<i>Chrysanthemum sp.</i>	*	*	*	*	*
10	<i>Tecomeria capensis</i>	-	-	*	*	-
11	<i>Lobularia maritime</i>	-	-	*	-	-
12	<i>Raphanus sativus</i>	*	-	*	*	*

13	<i>Gypsophila paniculata</i>	*	-	*	-	*
14	<i>Calliandra haematocephala</i>	*	*	*	*	*
15	<i>Matricaria sp.</i>	*	*	*	*	*
16	<i>Dahlia hybrid</i>	*	*	*	*	-
17	<i>Antirrhinum sp.</i>	*	-	-	-	-
18	<i>Lagerstroemia alba</i>	-	-	*	-	*
19	<i>Helliborus niger</i>	*	*	*	*	-
20	<i>Tecoma sp.</i>	*	*	*	-	-

Table 1 represents the Presence (*) or absence (-) of plants in each sub-division.

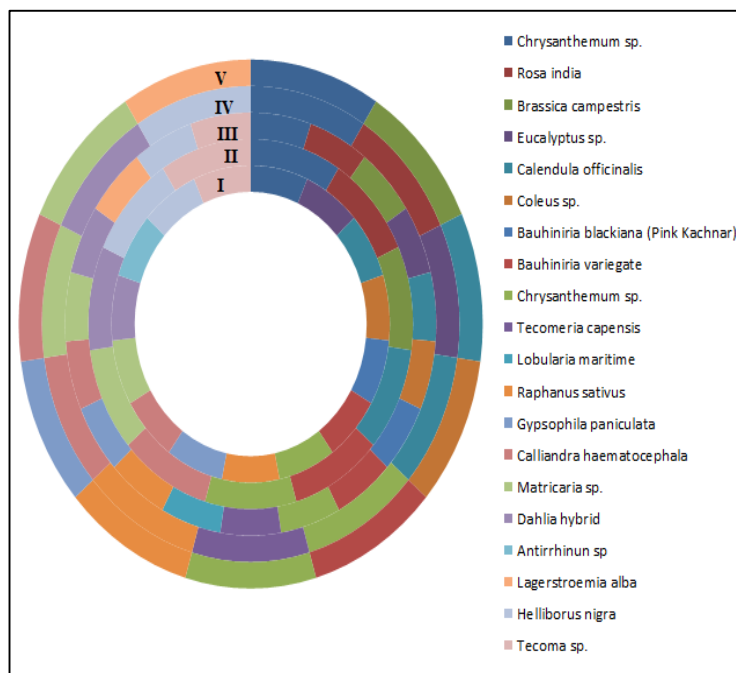


Figure 1 represents the Presence of plants in each sub-division

Table 1 reflects the flora richness of sub- division 3. Sub- division three has greater number of bee forage plants which were preferred by honey bees during winter. Nectar foragers usually visit during day time. Foraging activities and foraging preferences are greatly affected by day duration, weather and chemical composition of bee pollen. In figure 1, each ring represents single sub- division and each colour represents the presence of particular plant. The mean number of flowers visited by honey bees per minute and also the mean percentage of honey bee visit on each plant showed in table 2.

Table 2:

Name of Plants	Morning 700-800 (Mean number flowers visited by honey bee in one minute)	Afternoon 1300-1400 (Mean number flowers visited by honey bee in one minute)	Evening 1700-1800 (Mean number flowers visited by honey bee in one minute)	Mean Percent age (%) of honey bees visit on each plant	Mean time spend by honey bee on flower (mean ± s.e.m)	Source of pollen (P)/ nectar (N)
<i>Chrysanthemum sp.</i> (Ch1)	14.33	23.66	00	52.22	17.66±5.03	P**
<i>Rosa india</i> (R)	05	10	0.66	38.88	9.66±3.05	P**
<i>Brassica campestris</i> (Br)	16.33	26.66	04	87.5	14.33±3.51	P***,N***

<i>Eucalyptus</i> sp.(Eu)	7.33	14	1.66	45.83	26.66±8.08	P***,N***
<i>Calendula officinalis</i> (Ca)	02	5.66	00	45.83	14.33±2.51	P***
<i>Coleus</i> sp.(Co)	4.33	9.33	00	50	10.66±3.21	P**,N**
<i>Bauhiniria blackiana</i> (Pink Kachnar) (Ba b.)	7.33	18.66	06	51.19	13.66±1.15	P*,N**
<i>Bauhiniria variegata</i> (Ba v.)	3.66	14.33	00	42.22	13.66±2.08	P*,N**
<i>Chrysanthemum</i> sp.(Ch 2)	12.33	26.66	00	94.44	14±3.6	P**
<i>Tecomeria capensis</i> (Te c)	5.66	11.66	00	55.55	15±2.64	N***
<i>Lobularia maritime</i> (Lo)	05	18.33	00	55.55	14.33±2.51	P***,N*
<i>Raphanus sativus</i> (Ra)	00	10	00	55.55	7.66±1.52	N*
<i>Gypsophila paniculata</i> (Gy)	12.66	47.33	2	83.33	15.33±3.05	P***,N**
<i>Calliandra haematocephala</i> (Ca)	3.33	2.66	00	63.49	13±3.6	P*,N***
<i>Matricaria</i> sp.(Ma)	11.33	09	00	59.16	35±5	P***
<i>Dahlia hybrid</i> (Da)	00	11.33	00	83.33	12.66±4.5	P**
<i>Antirrhinun</i> sp. (An)	08	7.66	00	66.66	13.33±3.05	P**,N*
<i>Lagerstroemia alba</i> (La)	10	10	00	100	26±9.53	P**,N***
<i>Helliborus niger</i> (He)	12	11	00	88.88	33.33±16.5	P***,N***
<i>Tecoma</i> sp.(Te)	07	16.33	00	83	12.66±1.52	N***

Table 2: Mean number of flowers visited by honey bees and percentage of honey bees on each plant during observation. Mean time spend by honey bees on each flower was also observed. All these informations also concluded whether plant is pollen source or nectar source.

P*: Poor Source, P**: Average Source, P***: Good Source
N*: Poor Source, N**: Average Source, N***: Good Source

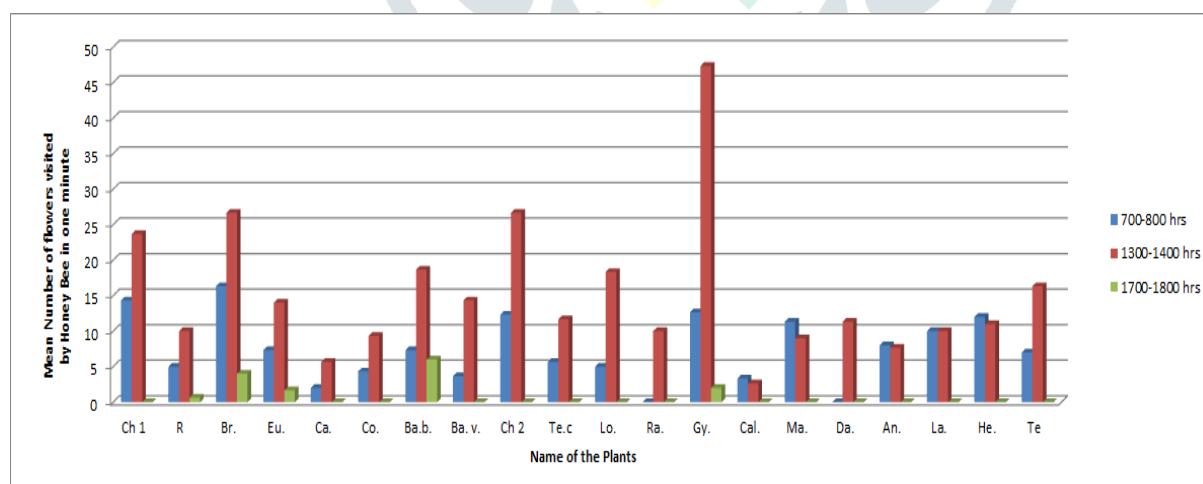


Figure 2: Graphical representation of data mentioned in table 2.

Table 2 shows that during winter day time is greatly preferred by honey bees for foraging. After sunset or in the evening hours no honey bee was found on plants for foraging because of very low temperature of the season. Even during day when temperature is very low honey bees preferred to stay in hive to maintain the temperature of hive for survival. As temperature rises from morning to afternoon, activities of honey bees also increases but near sunset when temperature falls the foraging of honey bees also declines. Temperature and other environmental factors are very important as they play very important role in honey bee foraging (Barbara *et al.*, 2015).

Some plants are like good source of both pollen and nectar like *Eucalyptus*, *Brassica campestris* and *Helliborus niger*. *Raphanus sativus* and *Dahlia hybrid* are poor source of pollen and nectar. Some plants were visited by honey bees for nectar as they were identified as good or average source of nectar. During their visit on plants, they

transferred and collected the pollen also. Many plants are good source of pollen like *Callendula officinalis*, *Gypsophila paniculata*, *Rosa indica* and *Charysanthemum sp.*

CONCLUSION: From the above observations it was concluded that Chandigarh has great diversity of bee forage plants during winter months. Diversity of each plant varies among each sub- division during winter which provides knowledge about area having maximum number of particular bee forage plants in each sub- division. Day time was the best for bee foraging study. This knowledge will be greatly helpful for to study relationship between plants, honey bees, pollination and environmental conditions. Apart from study area, it will also be helpful for maintaining small apiaries during winter months in sub- divisions having maximum diversity of bee forage plants.

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1) *Chrysanthemum sp.*



2) *Rosa indica*



3) *Brassica campestris*



4) *Eucalyptus sp.*



5) *Calendula officinalis*



6) *Coleus sp*



7) *Bauharia blackiana*



8) *Bauharia variegata*



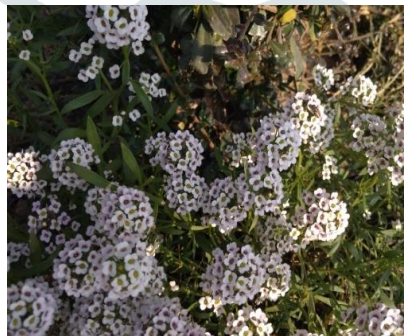
9) *Chrysanthemum sp.*



10) *Tecomera capensis*



11) *Lobularia maritima*



12) *Raphanus sativus*



13) *Gypsophila paniculata*



14) *Calliandra haematocephala*



15) *Matricaria sp*



16) *Dahlia hybrida*



17) *Antirrhinum sp*



18) *Lagerstroemia alba*



19) *Gossypium sp.*(Maxican cotton tree) 20) Tecoma tree

