MATERIALS AND METHODS

In the present investigations, melissopalynological studies have been conducted on honey samples and pollen loads of Indian hive bee, \textit{A. cerana}. Eco-Physiology of \textit{Plectranthus} spp. and other major honey yielding plants has also been studied. A comparison between foraging behaviour of \textit{A. cerana} and \textit{A. mellifera} in relation to \textit{Plectranthus} bloom has also been investigated.

MELISSOPALYNOLOGICAL STUDIES

Present melissopalynological studies included honey pollen analysis, pollen load studies and survey of honey yielding plants in Himachal Pradesh.

\textbf{Honey pollen analysis}

Analysis of pollen recovered from honey samples has long been used to identify their floral sources and even their geographical origins (Maurizio, 1975). This method gives a cumulative pollen spectrum of the nectar sources contributing to the honey over the whole period during which it was accumulated (Adams et al., 1979; Adams and Smith, 1981).

i) \textbf{Collection of honey samples}

Honey samples were collected from Indian hive bee, \textit{A. cerana} colonies located in different parts of Himachal Pradesh having different altitudes, latitudes and climatic conditions.
Places of collection of honey samples were: Bilaspur, Raipur, Kangra, Nalagarh, Mandi, Hamirpur, Sundernagar, Nahan, Arki, Chamba, Rampur, Baijnath, Janot, Kullu, Sabathu, Hatkoti, Kumarsein, Rohru, Solan, Banjar, Nirmand, Rajgarh, Kasauli, Jubbal, Shimla, Chopal, Chail, Bagi, Narkanda and Kalpa (Table 1, Fig. 1). In addition regular samples of honey were collected at weekly intervals from *A. cerana* colonies at Summer hill and Navbahar apiaries at Shimla. (31°-06'N latitude, 77°-10'E longitude and 2206 metres altitude) for one year (March, 1981 to February, 1982) with four colonies at each apiary without any signs of disease and no supplemental sugar syrup or pollen was fed to any of the experimental colonies. All the colonies were in two storey hives with seven frames in the brood chamber and the same number of frames in the super. All the colonies were of similar strength with equal amounts of brood and pollen stores. Collections were made from other localities of Himachal Pradesh, during their respective major honey flow seasons i.e. May-June and September-October of the years 1982 to 1986.

ii) Preparation of slides

Pollen slides of honey samples were prepared using the method of Louveaux *et al.* (1978), modified by Iwama and Melhem (1979). To prepare pollen slides of honey, 10 gm of honey was dissolved in 20 ml of hot distilled water at 40°C. This solution was centrifuged at 2500 rpm until the sediment settled. The supernatant liquid was drained off with a fine pipette. The
sediment was dispersed again and transferred into another centrifuge tube, centrifuged again for five minutes and sediment separated. It was then acetylated by adding sulphuric acid and acetic anhydride in the ratio of 1:9. The tube was then placed in a waterbath for ten minutes at 70°C and centrifuged after incubation for five minutes. The centrifuge tube was filled with distilled water and a drop of strong detergent (teepol) was added. It was again centrifuged for five minutes and a drop of glycerine and water mixture (1:1) added to the sediment. Then this sediment solution was transferred to the slides which were placed in an oven (40 to 45°C) to get surplus water evaporated. The pollen grains were mounted in glycerine gelatine.

iii) Identification, counting and recording of pollen grains

The pollen grains recovered from honey samples were examined microscopically and identified with the help of reference pollen slide collection of Apicultural laboratory of Bio-Sciences Department, Shimla and standard works of Erdtman (1960) and Nair (1964, 1985). These pollen types were then confirmed by comparing them with reference pollen slides deposited in the pollen herbarium of the Palynology laboratory, National Botanical Research Institute, Lucknow.

Pollen grains were studied under oil immersion for their markings, but their number was counted with haemocytometer. (Louveaux et al., 1978; Seethalakshmi, 1980; Suryanarayana et al., 1981). The absolute pollen count and percentages of pollen types
in each sample were then calculated (Sharma and Nair, 1965; Vorwohl, 1981; Chaturvedi, 1983) on the basis of total number of pollen grains counted in each sample and pollen spectra were constructed on the basis of these percentages. Honey samples having 45% or more grains of a single pollen type were termed as "unifloral honeys" and those having several pollen types in considerable percentage were termed as "multifloral honeys" following Iwama and Melhem (1979) and Chaturvedi (1983).

For the presentation of frequencies of pollen grains in honey, the system adopted by Louveaux et al. (1978) was used. The following terms have been used for frequency classes: predominant pollen (having more than 45% of the pollen grains counted); "secondary pollen" (16 to 45%), "important minor pollen" (3 to 15%) and "minor pollen" (less than 3%). The honey samples were considered rich, poor and extremely poor in pollen if the number of pollen grains per 10 gm of honey samples was above 1,00,000; 20,000 to 1,00,000 and below 20,000 respectively (Maurizio, 1975).

iv) Preparation of reference slides

The reference pollen slides were prepared by dipping the anthers or whole flowers of identified plants in acetic acid and keeping overnight. In the morning, this pollen material was transferred to heat resistant centrifuge tubes and covered with 5 ml of a mixture of acetic anhydride and sulphuric acid. This acetolysis mixture was prepared by adding the sulphuric
acid, drop by drop, to nine times the volume of acetic anhydride. This reaction mixture was heated in a water bath at 70°C, stirred thoroughly and transferred to the centrifuge. After centrifugation, 10 ml of water-alcohol mixture was added to the sediment and it was shaken thoroughly. After acetolysis and washing, one third of suspension in the centrifuge tube was transferred to another tube. It was then centrifuged again and to the sediment was added following reagents: 2 ml of glacial acetic acid, 1 or 2 drops of saturated sodium chlorate solution and 2 or 3 drops of conc. hydrochloric acid. After centrifuging the reaction mixture again, the sediment was washed with distilled water and suspended in a few drops of the mixture of glycerine and water in the ratio of 1:1. It was then centrifuged and supernatant was drawn off with a pipette and the pollen grains were mounted in the glycerine jelly (Louveau et al., 1978).

**Pollen load studies**

The pollen load studies provide useful information regarding bee preferences, related to flowering changes of bee forage plants (Sharma, 1970 a,b; Deodikar and Suryanarayanan, 1977).

1) **Collection of pollen loads**

Pollen loads of Indian hive bee, *A. cerana* were collected regularly twice a week from local apiaries of Summer hill and Navbahar (Shimla) from March, 1981 to February, 1982. Pollen load collections were also made from Bagi, Hatkoti, Jubbal and Chail areas during the major honey flow seasons of these
areas i.e. May-June and September-October of the years 1983 to 1986 (Table 1, Fig.1). The pollen loads were collected from the hind legs of incoming bees during different hours of the day.

ii) Preparation of slides

For the pollen load analysis, the pollen pellets were dispersed in water. The solution was then acetolysed according to the method of Erdtman (1960) and Sharma (1970 a, b). 1 ml of 50% glycerine was added to the sediment which was transferred to the slides. The smear was then allowed to dry and washed with several drops of ether. This pollen sediment was mounted in glycerine gelatine and covered with a cover glass. The slides thus prepared were sealed and studied microscopically. The field data and the pollen herbarium of Palynology laboratory, National Botanical Research Institute, Lucknow formed the basis for the identification of various pollen types. The terms used in describing the pollen loads are those used by Chaturvedi (1973, 1977): unifloral (with one pollen type) and multifloral (with more than one pollen type) loads.

iii) Weight and colour of pollen loads

These studies were conducted on the four colonies of A. cerana at Summer Hill and Navbahar apiaries (Shimla) for one year from March, 1981 to February, 1982. Ten foraging bees returning with pollen loads were collected at random at the entrance of the hive. Bees were kept in a test tube and anaesthesized with carbon dioxide (Von Frisch, 1967). These
bees were released after removing the pollen loads from left and right hind legs of each bee with a fine Camel brush. The pollen loads were immediately weighed and such observations were repeated twice a week in each month during different hours of the day.

Variations in the colour of pollen pellets collected by *A. cerana* in different seasons of the year for each hive were noted and results were expressed as percentage of pollen pellets. In order to study the seasonal variations in the weight and colour of pollen loads, experiments were carried out in spring (March-April), summer (May-June); rainy (July-August); autumn (September-October); early winter (November-December) and late winter (January-February) seasons.

**Survey Work**

Survey work of honey yielding plants was carried out in different parts of Himachal Pradesh which is mainly a hilly state lying between 30°-22' to 33°-12' N latitude and 75°-45' to 79°-04'E longitude in the lap of the north-west Himalayas. The physiography of Himachal Pradesh is almost mountainous with elevations ranging from 350 to 6500 metres above mean sea level and with an area of 56,019 sq.Km. Its northern border is bounded by Tibet, whereas, in the north-west it has a common border with Kashmir and the eastern border of the state is common with the hills of Uttar Pradesh. Average rainfall in the state stands at 1523 mm, although it varies from a minimum of 350 mm at Lahaul and Spiti to a maximum of 4400 mm at Dharamsala. The temperature
in the state varies according to elevation. From end of February, mercury rises gradually till June which is generally the hottest month in this region. With the onset of monsoons, there is a gradual fall in temperature. When the monsoon ends by middle of September, temperature falls gradually at first and fairly rapidly after November (Champion and Seth, 1968; Mani, 1981).

There are four major climatic zones in Himachal Pradesh which can broadly be classified as sub-tropical (low lying hills), sub-temperate (mid-hills), temperate (high hills and interior valleys) and cold and dry zone. Beekeeping is widespread with several potential honey producing areas in the first three zones and also some in a few warmer pockets of cold and dry zones.

**Sub-tropical zone**

This zone comprises of valleys and low lying hills near the plains of Punjab and Haryana. Altitude in this zone varies from 350 to 1000 metres with an annual rainfall between 600 to 1000 mm. This zone is very fertile and can be subjected to intensive cultivation.

**Sub-temperate zone**

This zone comprises of mid hills and the altitude varies from 1000 to 1550 metres above mean sea level. The climate of this zone is moderate with an annual precipitation ranging between 900 to 1000 mm.

**Temperate high hill zone**

This zone comprises of high hills and interior valley
areas with altitude varying between 1550 to 3000 metres above mean sea level. Annual rainfall varies from 900 to 1000 mm and snowing in winter is a usual feature.

**Cold and dry zone**

This zone lies between 3000 to 3700 metres above mean sea level. Annual rainfall is scanty and ranges from 250 to 400 mm. Bordering with Tibet, this zone is extremely cold and minimum temperature on an average comes down to -15°C.

Flowering plants (wild and ornamental) which were visited by honeybees to collect pollen and nectar, were collected from above zones of Himachal Pradesh during different seasons of the experimental years. These plants were identified with the help of local floras and taxonomists from Punjabi University, Patiala; Forest Research Institute, Dehradun and National Botanical Research Institute, Lucknow. A floral calendar of honey yielding plants of Himachal Pradesh indicating their taxonomic status, geographic location, honey potentiality and periods of flowering have been prepared (Table 12).

**ECO-PHYSIOLOGICAL STUDIES**

In Himachal and Kashmir regions of the Northern India, *Plectranthus* spp. is an excellent source of nectar for honeybees. This common shrub is found in great abundance and from this plant, honeybees make good store of honey. In the present investigations, detailed studies were made on the eco-physiology of *Plectranthus* spp. as a major source of honey in Northern India on the
following lines:

**Floral ecology and biochemistry of the nectaries**

Floral ecology of *Plectranthus rugosus* was studied by germinating the seeds of this plant in a B.O.D. incubator. Studies were made on the effect of different temperature conditions (i.e. 5°, 15°, 25°, 28°, and 30°C) on the germination of seeds of this plant. Regular observations were made at different hours viz., 24, 48, 72, 96, 120, 144 and 168 hours and results were expressed as the percentage germination.

Floral data was also recorded on the different phenotypic characteristics of *Plectranthus rugosus* by growing the seeds of this plant in the pots under glass house conditions at Shimla. Following parameters were recorded:

1) Number of flowers per branch
2) Number of flowers per plant
3) Number of healthy flowers per plant
4) Time for the complete opening of the flowers (Hours)
5) Size of buds (mm²)
6) Size of flowers (mm²)
7) Number of branches with flowers

Observations were taken daily for the above parameters during the months of September-October of the years 1985-1986.

Biochemical studies were conducted on the nectars of following honey plants in Shimla hills of the north-west Himalayas during 1985-86.
<table>
<thead>
<tr>
<th>Plant species</th>
<th>Common Name</th>
<th>Family</th>
<th>Period of Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Plectranthus rugosus</td>
<td>Wall. Shain</td>
<td>Lamiaceae</td>
<td>October, 1985</td>
</tr>
<tr>
<td>2) Plectranthus gerardianus</td>
<td>Benth. Shain</td>
<td>Lamiaceae</td>
<td>October, 1985</td>
</tr>
<tr>
<td>3) Plectranthus costeana</td>
<td>Buch. Ham.</td>
<td>Lamiaceae</td>
<td>October, 1985</td>
</tr>
<tr>
<td>4) Prunus cerasoides</td>
<td>D. Wild Cherry</td>
<td>Rosaceae</td>
<td>October-November, 1985</td>
</tr>
<tr>
<td>5) Adhatoda zeylanica</td>
<td>Nees Basuti</td>
<td>Acanthaceae</td>
<td>April, 1986</td>
</tr>
<tr>
<td>6) Pringepia utilis</td>
<td>Royle Bekhal</td>
<td>Rosaceae</td>
<td>September, 1985</td>
</tr>
<tr>
<td>7) Rosa moschata</td>
<td>Mill. Wild rose</td>
<td>Rosaceae</td>
<td>May-June, 1986</td>
</tr>
<tr>
<td>8) Berberis lycium</td>
<td>Royle Barberly</td>
<td>Berberidaceae</td>
<td>April-May, 1986</td>
</tr>
<tr>
<td>9) Rubus lasiocarpus</td>
<td>Smith Berries</td>
<td>Rosaceae</td>
<td>April-May, 1986</td>
</tr>
</tbody>
</table>

Nectar sugar contents of the flowers of the above plants were determined following the methods of Roberts (1979). For determining the sugar concentration in the nectars, floral buds were enclosed in nylon net cages and flowers were marked on their opening. Fresh nectary of the flower was dissected out and rinsed in 1 ml distilled water in a corked plastic tube and the flower was removed after 45 minutes. Rinsate was stored in the freezer and later on used for the quantitative determination of total sugar. To a known amount of rinsate (1 ml), 1 ml of 5% phenol solution was added. Further to this solution, 5 ml of concentrated
Sulphuric acid was added in such a way so as to avoid the
spattering and enable the thorough mixing and hot solution was
allowed to stand for 45 minutes so as to develop the colour.
Absorbance was measured at 490 nm with Spectronic - 20 (Bausch
and Lamb). For the determination of nectar sugar content,
35 replicates were maintained (each consisting of one flower)
for each plant species. Sugar contents in the unknown samples
were calculated using a standard curve, prepared by known
concentrations of dextrose. The results were expressed as
the amount of nectar sugar (mg) secreted by a single flower at
0800, 1100, 1500, and 1700 hours of the day.

**Comparative foraging behaviour of *A. cerana* and *A. mellifera* on
plectranthus bloom**

The foraging studies were conducted on the Indian hive
bee, *A. cerana* and European bee, *A. mellifera* in a local apiary
at Shimla (31°-06'N latitude, 77°-10'E longitude and 2206 metres
altitude) during August-September of years 1983 to 1985. The
observations were made on four colonies each of *A. cerana* and
*A. mellifera* with no signs of disease and no supplemental sugar
syrup or pollen was fed to any of experimental colonies. All
the colonies were in two-storey hives with seven frames in the
brood chamber and the same number of frames in the super. All
the colonies were of similar strength with equal amounts of brood
and pollen stores. Following parameters of foraging behaviour
of *A. cerana* and *A. mellifera* were studied in relation to
*Plectranthus* bloom:
a) Hourly fluctuations in the population of honeybee foragers visiting Plectranthus bloom

To assess the peak hours of foraging activity, hourly fluctuations were recorded in the activity of *A. cerana* and *A. mellifera* on Plectranthus bloom. The counts were made on two bushes for 10 minutes each during every hour from morning to evening. These observations were repeated for ten days during the blooming period of *Plectranthus rugosus* (Southwood, 1978; Verma and Chauhan, 1985).

b) Variations in the number of pollen, nectar and pollen plus nectar collectors

The relative number of bees foraging for pollen, nectar and pollen plus nectar were estimated following the methods of Park (1926) and Erickson et al. (1973). This was determined by closing the hives till twenty incoming bees were collected at the entrance of hive with a sweep net. These samples were collected daily during blooming period at different hours of the day (i.e., 0900, 1100, 1300, 1500 and 1700 hours). The honeybees were sealed in bags and immediately frozen to prevent regurgitation of the nectar. Bees carrying pollen loads in corbiculae on hind tibia were regarded as pollen collectors. For discrimination between nectar and water collectors, honey sac of each bee was placed out on Whatmann number 1 filter paper. If no visible stain was found after drying on the filter paper, it was considered to be water collector, otherwise classified as
nectar collector. Bees with both pollen and nectar loads were named as pollen plus nectar collectors. These observations were repeated for ten days during *Plectranthus* bloom at different hours of the day.

c) Foraging attributes

Various foraging attributes of *A. cerana* and *A. mellifera* were recorded regularly for ten days during the *Plectranthus* bloom. Following parameters were studied:

1) Time spent by bee per flower per visit
2) Number of flowers visited per bee per minute
3) Time taken to shift from one flower to another
4) Distance covered from flower to flower
5) Number of branches visited per bee per minute

Some of these parameters were recorded with the help of a stop watch giving an accuracy upto one-tenth of a second (Verma and Dulta, 1986).

d) Pollen loads at different hours of the day

Twenty foraging bees returning with pollen loads were collected at random at the entrance of the hive. Bees were kept in a test tube and anaesthetized with carbon dioxide (Von Frisch, 1967). The bees were released after removing the pollen loads from left and right hind legs of each bee with a fine Camel brush. These pollen loads were immediately weighed and such observations were repeated daily for ten days during different hours of the days i.e. 0900, 1100, 1300 and 1500 hours.
e) **Duration of each foraging trip**

For studying the duration of the foraging trip made by a forager, 20 bees of *A. cerana* and *A. mellifera* were marked with the help of coloured plastic discs in each colony. Time, when a marked bee left the hive and returned to the hive was recorded (Mattu, 1982). This data was collected at different hours of the day (0800 to 1800 hours) and repeated for ten days during the *Plectranthus* bloom.

**STATISTICAL ANALYSIS**

Data were analysed statistically using standard error about the mean and critical ratios. Analysis of variance, Duncan's multiple-range and t-tests were also applied for testing the significance of the results (Snedecor and Cochran, 1976).

The abbreviated titles of the periodicals in the 'references' are indicated according to "SERIAL SOURCES FOR THE BIOSIS DATA BASE TM" 1987 volume.
Table 1: Physiographic details of various places of collection of honey samples of *Apis cerana* from Himachal Pradesh.

<table>
<thead>
<tr>
<th>Locality</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Altitude (metres)</th>
<th>Rainfall (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bilaspur*</td>
<td>31°-15'N</td>
<td>76°-40'E</td>
<td>587</td>
<td>1622</td>
</tr>
<tr>
<td>Raipur^2 (Una)</td>
<td>31°-20'N</td>
<td>76°-23'E</td>
<td>650</td>
<td>679</td>
</tr>
<tr>
<td>Kangra^3</td>
<td>32°-05'N</td>
<td>76°-16'E</td>
<td>700</td>
<td>1623</td>
</tr>
<tr>
<td>Nalagarh^4 (Solan )</td>
<td>31°-02'N</td>
<td>76°-44'E</td>
<td>711</td>
<td>833</td>
</tr>
<tr>
<td>Mandi^5</td>
<td>31°-43'N</td>
<td>76°-50'E</td>
<td>761</td>
<td>1388</td>
</tr>
<tr>
<td>Hamirpur^6</td>
<td>31°-42'N</td>
<td>76°-25'E</td>
<td>790</td>
<td>1812</td>
</tr>
<tr>
<td>Sundernagar^7 (Mandi)</td>
<td>31°-32'N</td>
<td>76°-52'E</td>
<td>680</td>
<td>1455</td>
</tr>
<tr>
<td>Nahan^8 (Sirmaur)</td>
<td>30°-33'N</td>
<td>77°-21'E</td>
<td>905</td>
<td>2221</td>
</tr>
<tr>
<td>Arki^9 (Solan)</td>
<td>31°-09'N</td>
<td>76°-57'E</td>
<td>912</td>
<td>750</td>
</tr>
<tr>
<td>Chamba^10</td>
<td>32°-33'N</td>
<td>76°-10'E</td>
<td>1067</td>
<td>1193</td>
</tr>
<tr>
<td>Rampur^11 (Shimla)</td>
<td>31°-21'N</td>
<td>77°-45'E</td>
<td>1158</td>
<td>901</td>
</tr>
<tr>
<td>Baijnath^12 (Kangra )</td>
<td>32°-02'N</td>
<td>76°-38'E</td>
<td>1158</td>
<td>1719</td>
</tr>
<tr>
<td>Janot^13 (Sirmaur)</td>
<td>30°-38'N</td>
<td>77°-16'E</td>
<td>1201</td>
<td>1903</td>
</tr>
<tr>
<td>Kullu^14</td>
<td>31°-42'N</td>
<td>77°-08'E</td>
<td>1219</td>
<td>789</td>
</tr>
<tr>
<td>Sabathu^15 (Solan)</td>
<td>31°-02'N</td>
<td>77°-03'E</td>
<td>1323</td>
<td>1150</td>
</tr>
<tr>
<td>Location</td>
<td>Latitude</td>
<td>Longitude</td>
<td>Altitude</td>
<td>Number</td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------</td>
<td>-----------</td>
<td>----------</td>
<td>--------</td>
</tr>
<tr>
<td>HatkotI&lt;sup&gt;16&lt;/sup&gt; (Shimla)</td>
<td>31°-08'N</td>
<td>77°-45'E</td>
<td>1345</td>
<td>998</td>
</tr>
<tr>
<td>Kumarsen&lt;sup&gt;17&lt;/sup&gt; (Shimla)</td>
<td>31°-15'N</td>
<td>77°-31'E</td>
<td>1383</td>
<td>716</td>
</tr>
<tr>
<td>Rohru&lt;sup&gt;18&lt;/sup&gt; (Shimla)</td>
<td>31°-13'N</td>
<td>77°-43'E</td>
<td>1506</td>
<td>963</td>
</tr>
<tr>
<td>Solan&lt;sup&gt;19&lt;/sup&gt;</td>
<td>30°-50'N</td>
<td>77°-08'E</td>
<td>1521</td>
<td>1187</td>
</tr>
<tr>
<td>Banjar&lt;sup&gt;20&lt;/sup&gt; (Kullu)</td>
<td>31°-37'N</td>
<td>77°-21'E</td>
<td>1560</td>
<td>526</td>
</tr>
<tr>
<td>Nirmand&lt;sup&gt;21&lt;/sup&gt; (Kullu)</td>
<td>31°-25'N</td>
<td>77°-34'E</td>
<td>1600</td>
<td>671</td>
</tr>
<tr>
<td>Rajgarh&lt;sup&gt;22&lt;/sup&gt; (Sirmaur)</td>
<td>30°-51'N</td>
<td>77°-17'E</td>
<td>1627</td>
<td>1428</td>
</tr>
<tr>
<td>Kasauni&lt;sup&gt;23&lt;/sup&gt; (Solan)</td>
<td>31°-53'N</td>
<td>76°-56'E</td>
<td>1861</td>
<td>1689</td>
</tr>
<tr>
<td>Jubbal&lt;sup&gt;24&lt;/sup&gt; (Shimla)</td>
<td>31°-08'N</td>
<td>77°-40'E</td>
<td>1891</td>
<td>1018</td>
</tr>
<tr>
<td>Shimla&lt;sup&gt;25&lt;/sup&gt;</td>
<td>31°-07'N</td>
<td>77°-10'E</td>
<td>2206</td>
<td>1625</td>
</tr>
<tr>
<td>Chopal&lt;sup&gt;26&lt;/sup&gt; (Shimla)</td>
<td>30°-56'N</td>
<td>77°-37'E</td>
<td>2342</td>
<td>1112</td>
</tr>
<tr>
<td>Chail&lt;sup&gt;27&lt;/sup&gt; (Solan)</td>
<td>30°-07'N</td>
<td>77°-40'E</td>
<td>2361</td>
<td>1080</td>
</tr>
<tr>
<td>Bagi&lt;sup&gt;28&lt;/sup&gt; (Shimla)</td>
<td>31°-15'N</td>
<td>77°-27'E</td>
<td>2648</td>
<td>1518</td>
</tr>
<tr>
<td>Narkanda&lt;sup&gt;29&lt;/sup&gt; (Shimla)</td>
<td>31°-15'N</td>
<td>77°-27'E</td>
<td>2721</td>
<td>1375</td>
</tr>
<tr>
<td>Kalpa&lt;sup&gt;30&lt;/sup&gt; (Kinnaur)</td>
<td>31°-31'N</td>
<td>78°-08'E</td>
<td>2768</td>
<td>368</td>
</tr>
</tbody>
</table>

*Number assigned to a particular locality*
Fig.1  Map showing the places of collection of honey samples from Himachal Pradesh.
PLACES OF COLLECTION OF HONEY SAMPLES
MULTITUDE IN METRES

HIMACHAL PRADESH

INDIA

FIG 1