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Effect of Sugar solution feeding as an artificial diet on colonies of *Apis mellifera* L. In relation to survival and storage during Dearth period

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Abstract

During dearth period May to July, causes major drawback in feeding and resulted colonies collapse in vocational beekeeping. The temperature was recorded high 48° c during this period, thus, it was very difficult to honey bees to collect food. All colonies make with 10 frame be strength at the beginning of dearth period and these all were fed by artificial diet (Sugar solution and pollen substances) and it were recorded that the 7.8, 6.2,4.4 and 3.3 frame bee strength after passing dearth period, in case these all were fed at 1,2,3 and 4 week intervals, respectively. *Apis mellifera* colonies were fed with 500g sugar solution (1:1sugar and water) during dearth period may to July and it was very effective and beneficial for bee colonies. All those colonies, whom artificial diet was not provided timely, could survive till last week of June and then there were dwindled in first week of July.

Keywords: Honey bee (*Apis mellifera* L.), artificial diet (Sugar solution), and dearth period

1. Introduction

Crops and cropping pattern in the Gird zone have under gone in chances drastically during last two and half decades mainly because of introduction of irrigation through cannal network of Chambal and Harsi Dam. High favorable price of rapeseed and mustard, pigeon pea and cereals have also played an important role in changed the cropping pattern while millets and certain low yielder crops have replaced by high yielder crops in cropping sequence particularly in irrigated areas. The most of soils in the region belong to Alluvial groups, however, detailed soil survey of area has shown that the soil of the zone falls in four groups that is Alluvial soil, medium black soil, mixed red and black soil, and red and yellow soil. This zone has fluctuated trend in temperature. This can be characterized by as long duration summer and short duration winter with extremes of maximum temperature in the last week of May and minimum in the last week of December to first week of January.

The cropping system of the Gird zone provides sufficient flora for honey bees therefore, this zone of M.P. is a paradise for beekeepers not only for the state but also for neighboring states too. It has tremendous back up of bee flora from field crops as well as from horticultural crops. Therefore commercial bee keeping is very popular in this area from October to April. Beekeepers of this zone adopt the stationary and migratory beekeeping and place their apiaries in orchards and in vegetable growing areas during off season and in toria, mustard, and berseem crops preferably in honey flow season. Beekeepers from adjoining states migrate their apiaries in the month of October, November emigrating in the month of March – April. Abundant flora is available in this region round the year and favorable environmental conditions act as a catalyst to start and provide nectar and pollen to honey bees for food and resulting in abundant production of honey.

Honey bees *Apis mellifera* L. are fully dependent on flowers of different plants for pollen and nectar for their food and they are well known producers of raw honey, bees wax, royal jelly, propolis and venom. Honey bees increase the quality as well as quantity of most agricultural crops due to cross pollination too. In Chambal division of M. P. *Apis mellifera* are mainly dependent to use by rural youth bee keepers. Bee keeper faces a very difficult period during summer especially in months May and June where unavailability of flora is very meager. Growth of colonies stops which now get dwindled. Looking to the above facts and food crisis for honey bees in the gird agro-climatic zones of Chambal division especially during hot

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summer. Therefore the present experiment was conducted to study the effect of artificial diet (Sugar solution and pollen substances) at different intervals on colony survival, build up and honey store during dearth period

2. Materials and Methods

2.1 Description of the study area

Two villages Sirmoe ka pura and Mirghan were selected by scientists of Krishi Vigyan Kendra Morena district for collecting preliminary information of bee keeping and resource availability, it was found that the farmers of these villages maintain bees in despite of paucity of flora during the summer session.

2.2 Period, location and climate

The field experiment was conducted during summer 2012 and 2013 at five beekeeping units in two villages Sirmoe ka pura, Mirghan and KVK apiaries in Morena district of Gird agro climatic zone of Madhya Pradesh, situated in central India. Gird zone is in northern part in M.P. which lies between latitude 24 ° to 26 ° North and longitude 76 ° to 79 ° East. The height from mean sea level is 177 meters. The mean annual maximum and minimum temperature ranges from 50 to 2 °C. The average annual rainfall received 750 mm, out of which 90 per cent is received during rainy session 15th June to September. The soils of study area are deep black, medium black, sandy light and alluvial.

2.3 Experimental set up

From every bee keeping unit ten colonies of *Apis Mellifera* (Newly mated) and a total 50 colonies were selected. To simulate the natural condition and to observe a similar effect, all the selected colonies were equalized in the first week of May. All the treatments were undertaken with five replication e. i. T1- artificial diet (sugar solution) at weekly interval T2- artificial diet (sugar solution) at 2 week interval T3- artificial diet (sugar solution) at 3 week interval T4- artificial diet (sugar solution) at 4 week interval T5- without artificial diet (Control). Sugar solution for artificial diet feeding @ 50% concentration (1:1 sugar and water) was provided to the colonies starting from 10th May till the third week of July. 500 ml sugar solution as artificial diet was provided to each colony during morning hours. For the pollen purpose 100 g pollen substitute (25% gram flour, 25% soybean flour, 25% sugar,

25% skimmed milk, 10 g vitamin mixture and 10 g yeast per kg material) was also provided to all the experimental colonies including control in addition to the sugar solution at every week. Regular cleaning was done in colonies at weekly intervals to avoid other inflations and ant attack. The observations (bee strength, unsealed brood, sealed brood, honey and pollen) were recorded at a regular interval of ten days from 15th May to last August. XLSTATE (2007) was used for statistical analysis.

3. Results and discussion

The experiment was laid down during summer 2012 and 2013 and results are shown in table 1, 2 and 3. The sugar solution as an artificial diet was given to the *Apis mellifera* L. and bee strength in the colonies was on 10 frames. The sealed brood, un-sealed brood, pollen and average honey stores were 3025.0, 1510.0, 725.0 cm² and 900.0 gm, respectively (Table-1). High levels of brood rearing were observed (522.0 cm²), which colonies fed at 1 week interval (Table-2). Very little brood (58.4 and 14.3 cm²) observed in colonies, which were fed with sugar solution at 2 and 3 weeks intervals. Brood rearing was almost completely stopped (3.8 cm²) in colonies; these were fed at 4 weeks intervals and at par with control (2.0 cm²). Strong bee strength (7.8 no of frame) in colonies were maintained till last week of August in those colonies, which were fed with sugar solution at 1 week intervals, whereas bee strength was poor (4.2 and 3.2 no of frame) in those colonies, which were fed with sugar solution as an artificial diet at 3 and 4 weeks intervals. The very poor bee strength (1.0 and 1.2 no of frame) was recorded in control plot during last July and last August, out of these three colonies were dwindled during first week of August. Very little pollen store 3.9, 3.0, 2.6 and 2.1 cm² was found in those colonies, which were fed with sugar solution at an intervals of 1, 2, 3 and 4 week respectively, but colonies in control, without feeding artificially sugar solution maintained pollen store up to 87.6 cm², which might be due to no brood rearing in these colonies. Honey store was almost nil or very little amount 32.4 and 26.8 gm in all the treatments during last July and last August at 1 week interval. [6, 1] also confirmed these findings and reported that feeding of sugar solution at 1 week interval was very beneficial to *Apis mellifera* colonies in buildup and honey store during the dearth period.2.

Table 1: Status of colony build up and store in *Apis mellifera* L. colonies before artificial feeding during hot summer (dearth period).

Intervals of Sugar solution feeding	Average brood (cm ²)			Average stores	
	Sealed	Un-sealed	Total	Honey (g)	Pollen (cm ²)
1 week	3025.0	1510.0	4535.0	900.0	725.0
2 week	2999.0	1506.0	4505.0	905.0	722.0
3 week	3009.0	1502.0	4511.0	910.0	724.0
4 week	3013.0	1496.0	4509.0	908.0	721.0
Control (Feeding not provided)	3018.0	1505.0	4523.0	496.0	725.0
CD (p=0.05)	NS	NS	NS	NS	NS

Table 2: Effect of artificial feeding of sugar solution on colony build up and store in *Apis mellifera* L. colonies during last July 2012-13.

Intervals of Sugar solution feeding	Average bee strength (No. of frames)	Average brood (cm ²)			Average stores	
		Sealed	Un-sealed	Total	Honey (g)	Pollen (cm ²)
1 week	7.8	56.0	466.0	522.0	32.4	3.9
2 week	6.2	8.6	49.8	58.4	17.5	3.0
3 week	4.4	2.7	11.6	14.3	6.3	2.6
4 week	3.2	1.4	2.4	3.8	3.0	2.1
Control (Feeding not provided)	1.2	1.0	1.0	2.0	1.0	87.6

It is clear from the table-3 that at the end of dearth period or start of honey flow season, brood rearing as maintained by these colonies, which were fed with sugar solution at 1 and 2 week intervals gave 800.1 and 148.9 cm² brood area, respectively. Very little and negligible brood rearing 42.8 cm² was noticed in these colonies, which were fed at 3 week interval up to last August, but it was almost nil 6.7 cm² and stopped in these colonies, which were fed at 4 week interval and at par with control 2.0 cm², therefore again did not startup to end of dearth period. Good bee strength 7.8 and 6.2 frame were recorded in those colonies, which were fed with sugar solution at 1 and 2 week intervals, respectively and was found

suitable for further exploitation of honey flow during the season. Medium bee strength 4.4 frames was recorded in those colonies, which were fed at 3 week intervals. Poor bee strength 3.2 frame were left in those colonies, which were fed at 4 week interval. Such colonies were expected to build up very late in the heavy honey flow season up to January on mustard flora as compared to 1, 2 and 3 week interval feeding. Above results were confirmed by the findings of [1, 3, 2] and similar results were also reported by [4] & found that *Apis mellifera* visited mustard flowers maximum in February but reduced with paucity of food.

Table 3: Effect of artificial feeding of sugar solution on colony build up and store in *Apis mellifera* L. colonies during last August 2012-13.

Intervals of Sugar solution feeding	Average bee strength (No. of frames)	Average brood (cm ²)			Average stores	
		Sealed	Un-sealed	Total	Honey (g)	Pollen (cm ²)
1 week	7.8	302.0	498.1	800.1	26.8	4.8
2 week	6.2	93.6	55.3	148.9	13.2	3.6
3 week	4.4	22.8	20.0	42.8	8.5	2.9
4 week	3.2	3.4	3.3	6.7	3.9	3.0
Control (Feeding not provided)	1.0	1.0	1.0	2.0	1.0	56.2

It was revealed from the table 3, that no pollen store was left in colonies, which were fed with sugar solution at 1, 2, 3 and 4 week interval, however, control colonies (in which no sugar fed) were left with 56.2 cm². Honey store was almost nil i.e. 26.8 gm in all the treatment in including those colonies, which were fed at 1 week interval. [5] Hence advised that the food storage cause quick dwindling and even perish bee colonies, beekeepers should go for judicious feeding of sugar solution for the survival. On the basis of data recorded at 10 days intervals on colony build up, this was considerable brood rearing continued in those colonies, which were fed with sugar solution as an artificial diet at 1 and 2 weeks interval.

4. Conclusion

Over all on the basis of above results, it can be concluded that feeding of sugar solution to *Apis mellifera* L. as an artificial diet during dearth period at 1 and 2 week interval is as good, as 3 week interval as satisfactory and 4 week interval as a poor. Feeding at 1st and 2nd week interval, sugar solution enough for further buildup of colonies and in relation to bee strength, brood rearing, and pollen and honey storage. Feeding of sugar solution during hot summer is beneficial in maintaining bee strength in colonies without it survival percent

of colonies of *Apis mellifera* is poor during the dearth period to honey flow season.

5. References

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