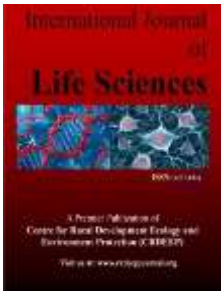
Vol. 12 . No.4. 2023.

DOI: 10.13140/RG.2.2.33229.45288

Contents available at:
http://www.crdeepjournal.org

International Journal of Life Sciences (ISSN: 2277-193x) ;SJIF: 6.431
UGC Accepted based on Peer Reviewed Journal



Full Length Research Paper

Different formulations of Pollen Substitute and Impact on *Apis Mellifera* Diet in Dried Condition

Rahul Sharma[1], Shailendra Sharma[2], G.D. Sharma[1], Kavya Manwani[2]
[1]*Department of Zoology, P.M.B. Gujrati Science College, Indore [M.P] India*
[2]*P.G. Department of Zoology, Sanskar College of Professional Studies, Indore [M.P] India*

ARTICLE INFORMATION

Corresponding Author:
Shailendra Sharma

Article history:
Received: 02-12-2023
Revised: 10-12-2023
Accepted: 18-12-2023
Published: 22-12-2023

Key words:
Pollen substitute, Dearth period, pollen patty, nutrition, productivity, honey bee, Apis mellifera, Mandav.

ABSTRACT

During times of scarcity, honey bee colonies have to struggle for their survival. The bee population needs to be maintained in colonies by feeding them artificially nutritious food. Throughout this study, an attempt was made to create a pollen supplement for Apis mellifera that is extremely appealing, nutritionally balanced, and commercially feasible.From patty feeding experiments carried out on bee colonies during summer and rainy dearth periods in Manday in 2021. it is concluded that bee-sup, diet 4 and diet 3 formulated in the laboratory was consumed in higher quantity as compared to other diets.

Introduction

Bees produce a variety of products in addition to delectable honey, including propolis, royal jelly, and bee venom. Through cross-pollination, they increase agricultural crops' yield as significant pollinators of a wide range of crops. (Kumar, M, et al, 2021). The typical diet of honey bees consists of pollen, nectar, and water. However, since pollen and nectar are seasonal in certain countries, honey bees may experience a period of dearth. During this time, the number of bee colonies may decline, which could have a negative impact on the amount of honey produced in the upcoming season. (Abbas, T, et al, 1995) Bee colonies experience periodic times of scarcity, which lead to the depletion of their food supplies and nutritional reserves. Queen bees lay fewer eggs when they are not eating enough food high in protein. Colony performance and strength deteriorate when worker bees cease raising new queens. A protracted lack of bee flora might occasionally cause bee colonies to die. Poor bee colonies can occasionally come under assault from bee enemies including wasps, ants, wax moths, bee eating birds, and wild bee robbing. Bee colony management is therefore becoming increasingly challenging.Kumar, R, Mishra RC, Agrawal OP. (2013).

Artificial diets are frequently used by beekeepers to replenish lost protein, fat, vitamins, and minerals in situations when natural pollen is or unavailable (Mortensen et al., 2019). If these diets don't contain any natural pollen, they are referred to as pollen replacements; if they do, they are called pollen supplements. Pollen replacements were first used in the United States and Canada in the early 1900s (Manning, 2018). Researchers that devoted their lives to studying pollen substitutes and honey bee nutrition were Mykola H. Haydak and Elton W. Herbert Jr. (Manning, 2018). They employed brewer's yeast and other types of soy flour as the foundation for diets in several of their early investigations. In pollen replacements, they are still a popular, affordable, and easily available source of protein. Along with many other substances, pea protein, potato protein, maize gluten, egg products, milk products, and blood meal are also often used in pollen replacements (Brodschneider and Crailsheim, 2010; Saffari et al., 2010a; Mortensen et al., 2019). Various diets and feeding techniques are employed by beekeepers nowadays. Pollen replacements are usually placed directly above the beeboxes in patty form by beekeepers (Noordyke, E. R., & Ellis, J. D. 2021).

Materials and methods

Feeding experiments were conducted during summer (April, May, June) and rainy (July, August, September) season of 2021 in the experimental colonies. Bees were kept in Langstroth wooden hives and equalized in term of brood and honey stores. The details of method adopted are mentioned below.

Colony equalization: For feeding experiment, Apis mellifera colonies were procured from registered beekeeper and maintained in Mandav, Madhya Pradesh, India, located at latitude 22.3340 N and longitude 75.4003 E. Six boxes having colonies of almost similar strength were selected, numbered and labelled. Fresh queens were maintained in all colonies and were given equal brood and honey stores measured by gridding method (Seelley and Mikheyev, 2003; Amir and Peveling, 2004). Similar equlaization of colonies was made during the year before the start of experiment.

Diet preparation: The protein and carbohydrate ingredients were selected keeping in mind the nutritional requirements of honey bees. These ingredients were mixed in specific ratio to prepare a complete formulation (Table 1).
This formulation was named bee sup during the current study. The diet was prepared by adding suitable quantity of water and left overnight so that all components may get properly mixed. Next day, patties (dough form) of diet were prepared and wrapped in butter paper to prevent moisture loss. This investigation was carried out at the Mandav, M.P.

Table-1 Composition of diet formulations used during study-

Diet 1	DSF-15%	BY-15%	PG-15%	S-40%	G-15%	---------
Diet 2	DSF-20%	BY-20%	SP-10%	S-35%	G-15%	---------
Diet 3	DSF-15%	BY-15%	PH-15%	S-40%	G-15%	---------
Diet 4	DSF-15%	BY-15%	PH-10%	S-35%	G-15%	P-10%
Diet 5	----------	---------	SP-20%,	--------	--------	H-80%
Diet 6	DSF-30%	BY-10%	SKM-10%	S-50%	--------	---------

DSF: Defatted Soy Flour, PG: Parched Gram, BY: Brewer's Yeast, SKM: Skimmed Milk Powder, PH: Protein Hydrolysate, SP: Spirulina, P: Pollen, S: Sugar, G: Glucose, H: Honey

Top bar feeding and consumption: Weighed amount (100 g) of diet patties was placed on top bars, inside the hives for feeding, with few small holes on both sides. The patties were replaced with fresh patties after every seven days interval and the left-out diet patties were weighed using electronic weighing balance.

Measuring colony parameters: Egg laying, area of brood coverage and honey stores in the colonies were measured after every 21 days interval, with the help of wire grid frame consisting of squares of one inch^2 (Seeley and Mikheyev, 2003; Amir and Peveling, 2004).
The values were then converted into cm^2 by multiplying with a factor of 6.45. Bee strength in terms of total number of bees covered frames was also checked and recorded. Bee population was recorded by photographic print method (Jefree, 1951).

Statistical analysis: The experimental design used in the study was Completely Randomized Design (CRD). Data on feed consumption, sealed and unsealed brood area, bee population, bee covered frames, honey area was tabulated, transformed and statistically analysed by two-way ANOVA. Means were compared using critical differences (C.D.) at 0.05 per cent level of significance.

Results

A detailed investigation on six selected diet formulations was carried out during dearth period (summer and rainy season) at Mandav (M.P.). Different parameters of colonies were analyzed i.e., amount of sealed brood, egg laying, number of frames covered by bees, bee strength and honey stores, at the end of experiment. In all the experimental colonies, parameters were calculated to be better as compared to control colonies. Results obtained are presented in table 2, 3

In experimental site during summer season, the colonies given diet 1, 2, 3, 4, 5 and 6 the percentage of egg laying was 45.5, 43.1, 52.3, 55.1, 50.4, 43.0. The unsealed brood area was calculated to be 16.6, 47.6, 55.2, 57.1, 52.5, 23.6 The sealed brood area was calculated to be 24.0, 36.6, 37.3, 40.7, 35.1, 27.4The population of bee colonies was found to be 1.1, 0.6, 9.3, 4.3, 1.4, 1.7. The bee covered frames were 1.4, 2.8, 10.2, 7.5, 8.4, 1.5. Honey stores were found to be 36.2, 40.6, 39.3, 40.4, 35.3, 27.0. (Table 2)

In experimental site during rainy season, the colonies given diet 1, 2, 3, 4, 5 and 6 the percentage of egg laying was56.8, 54.2, 65.3, 68.8, 63.0, 53.75. The unsealed brood area was calculated to be 20.75, 59.5, 6.9, 71.3, 65.6, 29.5. The sealed brood area was calculated to be 30.0, 45.7, 46.6, 50.8, 43.8, 34.25. The population of bee colonies was found to be 1.37, 0.75, 11.6, 5.37, 1.75, 2.12. The bee covered frames were 1.75, 3.5, 13.1, 9.37, 1.08, 1.87. Honey stores were found to be 45.2, 50.7, 49.1, 50.5, 44.1, 33.7. (Table 3)

Table 2: Table Showing value of various parameters of colonies with different diet in Mandav, (M.P.) region during summer season (April, May, June) 2021

Diet	Value of various parameters in percentage					
	Egg Laying	Unsealed Brood	Sealed Brood	Bee Population	Bee covered frames	Honey Stores
Diet1	45.5	16.6	24.0	1.1	1.4	36.2
Diet2	43.1	47.6	36.6	0.6	2.8	40.6
Diet3	52.3	55.2	37.3	9.3	10.2	39.3
Diet4	55.1	57.1	40.7	4.3	7.5	40.4
Diet5	50.4	52.5	35.1	1.4	8.4	35.3
Diet6	43.0	23.6	27.4	1.7	1.5	27.0

Table 3: Table Showing value of various parameters of colonies with different diet in Mandav, (M.P.) region during rainy season (July, August, September)2021

Diet	Value of various parameters in percentage					
	Egg Laying	Unsealed Brood	Sealed Brood	Bee Population	Beecovered frames	Honey Stores
iet1	56.8	20.75	30.0	1.37	1.75	45.2
Diet2	54.2	59.5	45.7	0.75	3.5	50.7
Diet3	65.3	69.0	46.6	11.6	13.1	49.1
Diet4	68.8	71.3	50.8	5.37	9.37	50.5
Diet5	63.0	65.6	43.8	1.75	1.08	44.1
Diet6	53.75	29.5	34.25	2.12	1.87	33.7

The cost analysis was worked out on the basis of prices of various ingredients used to prepare artificial diet formulations. The final cost of different diets is shown in Table 4. The cheapest formulation was diet no. 1 with a cost of Rs. 80.4/kg followed by diet no. 3 (Rs.122 /Kg), diet no. 4 (Rs. 28/kg), diet no. 2 (Rs. 12.4/kg), diet no. 6 (Rs. 170/kg) and the costliest diet no. 5 (Rs. 310/Kg).

Table 4: Price list of various diets in Rupees

DIET	PRICE/KG
DIET 1	80.4
DIET 2	142.4
DIET 3	122.4
DIET 4	128
DIET 5	310
DIET 6	170

Discussion

Artificial meals that supplement or replace pollen can be useful in encouraging honey bee colonies to raise young, but they also need to be nutrient-dense and appealing to the bees. Beekeepers frequently gather honey in excess before the season of dearth, which prevents colonies from surviving owing to a lack of food. Because of all these factors, beekeepers are forced to adhere to the colony movement idea, which requires a significant investment of time, money, and work. A number of colonies could die in transit as a result of mishaps, bad scheduling, and poor site selection. Studying colony characteristics at a time of scarcity can be beneficial to beekeeping management in a number of ways, aside from colony movement. Calculating the severity and impact of a dearth period and the quantity of pollen replacement that bee colonies should receive at different points throughout the dearth period might be aided by studying several colony metrics during dearth times. Consequently, in order to support commercial beekeeping in India, efforts should be undertaken to develop a very appetizing and nutritionally balanced pollen alternative to aid the colonies during their time of shortage. The most persistent issue in apiculture research has been the beekeeping industry's long-standing interest in the need for artificial meals for honey bees.

References

Abbas, T., Hasnain, A., & Ali, R. (1995). Black gram as a pollen substitute for honey bees. Animal Feed Science and Technology, 54(1–4), 357–359.

Brodschneider, R., & Crailsheim, K. (2010). Nutrition and health in honey bees. Apidologie, 41(3), 278–294.

Kumar, R., Agrawal, O.P. (2014). Comparative performance of honey bee colonies fed with artificial diets in Gwalior and Panchkula region. Journal of Entomology and Zoology Studies. 2: 104-107.
Kumar, M., Abrol, D., Sharma, D., Vikram, U. S., & Singh, A. K. (2021). Impact of artificial diets on performance of Apis mellifera colonies during dearth periods. Journal of Entomology and Zoology Studies, 9(3), 404–409.
Kumari Indu, Kumar Rajesh (2019). Pollen Substitute Diet for Apis Mellifera: Consumption and Effects on Colony Parameters in Sub-Tropical Himalaya. Indian Journal of Agricultural Research. 54(2): 147-153.
Manning, R. (2018). Artificial feeding of honeybees based on an understanding of nutritional principles. Animal Production Science, 58(4), 689-703.
Mortensen, A. N., Jack, C. J., Bustamante, T. A., Schmehl, D. R., and Ellis, J. D. (2019). Effects of supplemental pollen feeding on honey bee (Hymenoptera: Apidae) colony strength and Nosema spp. infection. J. Econ. Entomol. 112, 60-66.
Noordyke, E. R., & Ellis, J. D. (2021). Reviewing the Efficacy of Pollen Substitutes as a Management Tool for Improving the Health and Productivity of Western Honey Bee (Apis mellifera) Colonies. Frontiers in Sustainable Food Systems, 5.
Saffari, A.M., Kevan, P.G., Atkinson, J.L. (2010). Consumption of three dry pollen substitutes in commercial apiaries. Journal of Apicultural Science,54:5-11.