

# The Effect of Pollen Supplementary Feeding on the Production of Honeybee (*Apis mellifera*) During Dearth Periods Under Haro Sabu Condition of Kellem Wollega Zone, Western Ethiopia

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## Abstract

To have the required colony population, feeding the colony is very crucial when there is a shortage of bee flora in the environment. The aim of this study is, therefore, to test the effect of pollen supplementary feeding during dearth period (2015/16 to 2016/17) at apiary site of Haro Sabu Agricultural Research Center of Kellem Wollega Zone, Western Ethiopia. Three treatments namely: Chick pea (*Cicer arietinum*), Mung bean (*Vigna radiata*) and Soybean (*Glycine max*) each with four replication by Completely Randomized Design was used. From the result, all the fed types consumed by the bee colonies and they were more consumed during dry season than rainy. Statistically, there was no significant difference ( $p>0.05$ ) observed between the given fed group. From the internal data recorded, the colonies which fed different supplementary pulse flour invests more than the unfed group. Therefore, it can be concluded that, giving pollen supplementary feeding at the time of dearth period maintains the strength of bee colony within the hive and attain to the next natural pollen and nectar flow season.

**Keywords:** Chick pea, Colonies, Mung bean, Pollen, Soya bean,

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## 1. Introduction

A colony population of at least 450,000-50,000 adult bees and 36,000-45,000 developing bees in the brood cycle are required to produce economically excess honey (Al-Ghamdi, 2002). To achieve these levels, colonies require good stimulating quantities of nectar and pollen. Pollen grains are the male germs of flowers and major source of protein to honeybee colonies (Buchmann and Orourke, 2011), and used to feed developing larvae and young bees to provide structural elements of muscles and glands. Moreover, it is also used in the production of royal jelly, which is a specialty food produced by nurse bees and fed to the queen, developing queen larvae, and worker larvae up to 72 hours of age (Alqarni 2006). At the time of dearth period, pollen supplementary feeding help the colony to survive, more populous and productive (Alghamdi, 2002). The development of pollen substitute diet has been the interest of the beekeepers to solve problem of dearth period (Fleming *et al.*, 2015). These substitutes constitute a wide range of components such as soybean based products (Kulincevic *et al.*, 1982), yeast micelle and in a lot of cases powder milk (Zaytoon *et al.*, 1988; Ranna *et al.*, 1996).

Maintaining a good strength of honeybee colony is a major problem that raised as a main constraint by beekeepers during a dearth period in Western Oromia in general and Haro Sabu in particular. According to study by Faisal and Khalil (2011) during shortage of pollens in nature, providing suitable supplementary feeding to honey bees is important to save their nutritional requirements and continues their activities during active periods in the local environment. Pollen supplement diets containing 20% or more soybean flour are highly palatable to bees and have the nutritive requirements for their growth and reproduction (Mattila and Otis, 2006). Low cost, attractiveness to bees, availability and nutritional values of substances are factors to be recommended as pollen substitutes (Somerville, 2000). Circumstances under which feeding supplements benefits colonies varies from location to location. The aim of the present study was therefore to test the effect of artificial pollen supplementary feeding for maintaining colony strength during dearth period at Haro Sebu condition.

## 2. Material and Methods.

The experiment was performed at Apiary site of Apiculture Research team, Haro Sabu Agricultural Research Center during dearth period starting from September 2015/16 to June 2017/18 G.C. For this activity, 20 (twenty) Honey bee colonies were obtained from a farmer beekeepers of the study area. During hive construction, except for control treatment (unfed group), hole was formed at the back of the hive which passed the bees to receipt the diet but caged by mesh wire to decrease nutrient competition from external colonies. In the first week of October 2015 which is the transferring period of honey bee colonies at the study area, colonies were transferred in to the prepared Zander frame hives. During transferring to familiarize the strength of colonies and minimize errors equal combs like pollen, brood, nectar and honey were fixed to equal number of frames for treatments from the transferred traditional hive and 1:1 sugar syrup was fed. At the end of October, 16 (sixteen) bee colonies which are well settled and very similar strength based on the internal resources were selected, numbered, labeled and

divided in to four (4) specific treatments (1: sole soy bean flour, 2: sole gram bean flour, 3: sole chickpea flour and 4: control (without feeding)). Each treatment was replicated four(4) times by completely randomized design (CRD).

Feeding of different pollen substitute was done externally to provide bees' easy to collect as did for natural pollen. According to Safari *et al.* (2010) honey bees by nature need to buzz to collect powdery substances which is an easy method and consumes minimum time and labor. The time of providing supplementary feeding was done from February to March and July to August which are the time of dearth periods in the study area. Supplementary feeding was suspended when diets flour consumption stopped by honey bees because of the availability of natural pollen (Mattila and Ottis, 2006). The pollen and brood area in the colonies were recorded for every 21 days interval with the help of measuring frame (wire grid) consisting of squares, each of one inch<sup>2</sup> (Sena, *et al.*, 2012, Kumar *et al.*, 2013). The values thus obtained was converted in to cm<sup>2</sup> by multiplying with a factor of 6.45. Total bee strength was measured in terms of frames actually covered by bees (Keller, *et al.*, 2005). Bee strength of all the experimental colonies was recorded at an interval of 21 days which is the developmental period of worker honey bees. For all treatments seasonal colony management was applied. The preparation of different flour is that, it was roasted and the skin of different flour come out and powdered to the texture and consistency to be accepted by honey bees and water was added to the weighted powder until it turns to soften texture (Tolera Kumsa, 2014).

### 2.1. Data analysis

SAS version 9.1.3 (SAS Institute, 2003) computer package was used for analyzing all the data. Means and standard deviations of the recorded data were calculated using SAS Software (SAS Inc., 2003). Determination of the significant differences between honey samples was done using one-way ANOVA. Consumption rate, number of frame with bees, pollen, brood, nectar and honey area in cm<sup>2</sup> on frame were used for mean separation.

## 3. Result and Discussion

### 3.1. Consumption rate of feeding

The mean consumption rate of each feeding types that were applied during dry season are indicated in Figure 1. The utilization rate (gram/colony) of each feed type was found slightly in ascending for each consecutive days during dry season (March). From the feed types, Mung bean found more preferred by a colony with a mean of 208.722 gram per colony while Soya bean was the less consumed with a mean of 191.406 gram per colony during dry season (Figure 1). At the time of rainy season, the consumption rate of each diet by colonies was increased during the first to fourth days while decreased on the fifth days.

From Figure 2, it can be observed that the maximum and minimum flour rate of the given diet was consumed by mung bean (28.5gram/colony) and chickpea (13.98gram/colony) respectively during rainy season (July to August). Honey bees prefer diets that return the proper ratio of nutrients necessary for optimal survival and homeostasis by evaluating the nutritional composition of the feeds provided to them (Corby-Hurris *et al.*, 2018)

The present study showed that bee colonies utilized more of the given feed type at the period of dry season than rainy season of the study area. This might be during rainy season the bee foragers are not active due to chilling. According to investigation by Riessberger and Crailsheim (1997), on sunny days foragers were too busy with almost no periods of inactivity while due to a lack of light they prevented from flight. Tolera Kumsa (2014) proved that high daily consumption of pea flour is 348.9 and 128 gram per colony in dry and rainy season respectively, and honeybees stored enough flour in combs for further consumption.

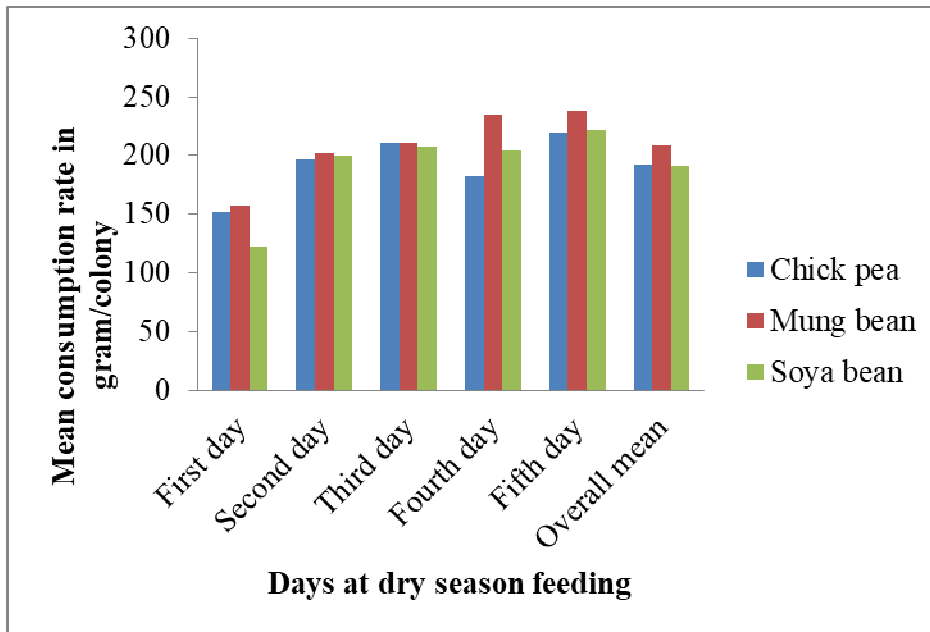


Figure 1: Mean consumption rate of the feeding during dry season

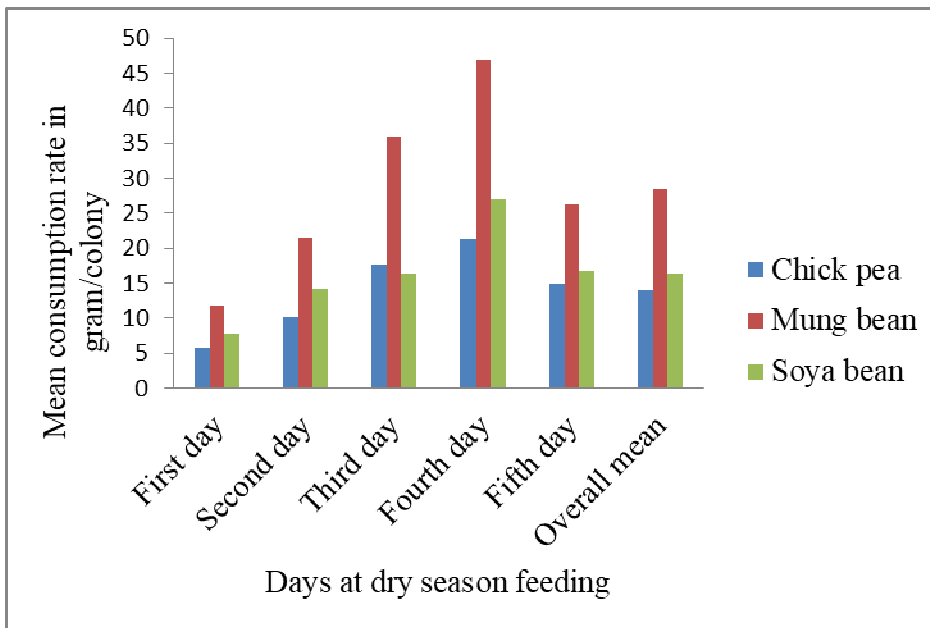


Figure 2: Mean consumption rate of the feeding during rainy season

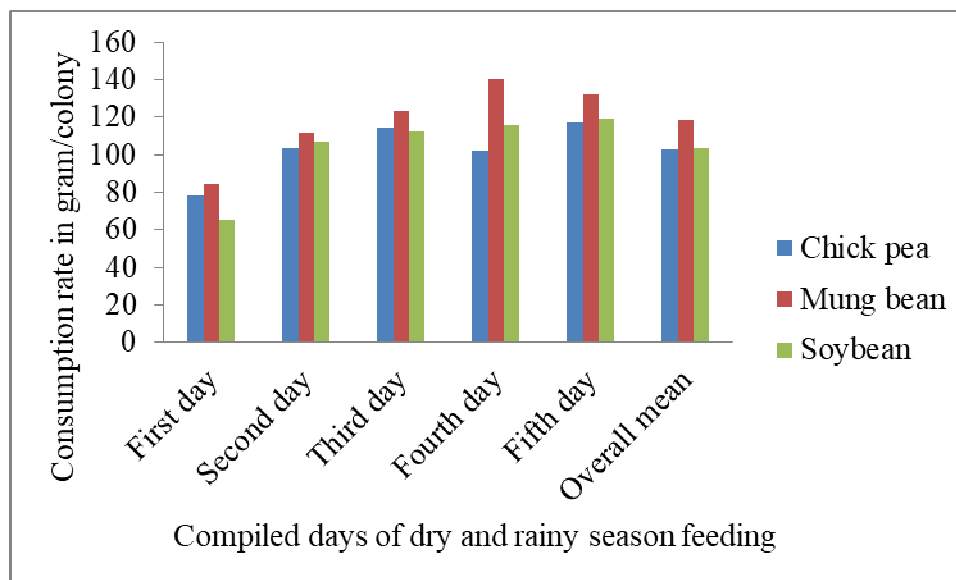


Figure 3: Mean consumption rate of 2015/16 and 2016/17 years

### 3.2. Number of frame with bees

The average number of frame with bees are indicated in Table 1. Statistically no significant ( $p > 0.05$ ) variation between feed types was observed except colonies without supplementary feeding. The highest frame with bees was counted by mung bean (6.66) as compared with the least which is unfed (3.28) colony. This study is less than the result by Tolera Kumsa (2014), who recorded an overall average of  $9.7 \pm 2.6$  frames of bees fed on pea flour. Kumer and Agrawal (2013) reported that number of bee covered on frames are positively affected by feeding protein-rich diet to bees.

### 3.3. Brood and pollen area on frame (cm<sup>2</sup>)

No statistically significant difference ( $p > 0.05$ ) was observed between the supplementary feeds given on brood area on frame (cm<sup>2</sup>) during dearth period of the study area. The maximum mean of brood area on frame was recorded by soybean (740 cm<sup>2</sup>) whereas the unfed colony produces (275 cm<sup>2</sup>) from a natural pollen. The present study result is less than the finding of Tolera Kumsa (2014) who recorded  $1274.3 \text{ cm}^2 \pm 195 \text{ cm}^2$  after feeding a colony with pea flour in dearth period. The variation occurred might be due to the difference in nutritional composition of the feed, bee strength and the environment of the apiary site.

Prakash, *et al.* (2007) have indicated that when there is unavailability of pollen and nectar around the apiary area, supplementing artificial pollen maintain the colony strength throughout dearth period and help the colony improve brood strength. Al-Gamdi (2002); Dastouri *et al.* (2007) and Abusabbah *et al.* (2012) have obtained from feeding of soybean flour singly or in combination with other flour indicate its high potential for improving colony maintenance and build brood production during a shortage of natural pollen.

Different feed types were analyzed after feeding the colonies for pollen storage on the comb and recorded on the 21<sup>st</sup> days of feeding. From the result (Table 1), no significant difference ( $p > 0.05$ ) was recorded between diet types. soybean fed colonies stored more pollen (236.9 cm<sup>2</sup>) as compared with unfed colonies (83.7 cm<sup>2</sup>). The percentage of protein content was high by soya bean (35–52) which is followed by mung bean (27.2) and chick pea (22.7), (Vollmann, 2016). Pea, chickpea and soybean flour are relatively contain high protein and locally easily available as compared to other bee feeding materials and preferred as pollen supplements (Somerville, 2005).

### 3.4. Nectar and honey area on frame (cm<sup>2</sup>)

The average nectar and honey area on frame were indicated in Table 1. The highest nectar (1396.9 cm<sup>2</sup>) and honey (2096.9 cm<sup>2</sup>) was found on the frame which fed the soybean flour while unfed colonies collects a smaller amount of nectar (170.3 cm<sup>2</sup>) and honey (349.2 cm<sup>2</sup>). From this study, a direct proportional result was observed on the number of frame with bees, brood, pollen, nectar and honey area in cm<sup>2</sup> on 21<sup>st</sup> days on application supplementary feeding.

According to the experimental result by Tolera Kumsa (2014), pea flour experimental group have good influence on dearth period brood production, colony population and honey production. Somerville and Collins (2007) have suggested that colonies maintained with pollen supplements in dearth periods would be in a better position to develop early brood production, accumulate nectar and stored surplus honey.

Table 1: Mean internal data of pollen supplementary feeding

Fed type	Chick pea (Mean ± SD)	Mung bean (Mean ± SD)	Soya bean (Mean ± SD)	Unfed (Mean SD)	±	LSD	p- value
No of Frame with bees	5.75±1.5 <sup>a</sup>	5.81±1 <sup>a</sup>	6.66±2 <sup>a</sup>	3.28 <sup>b</sup>		2.0649	0.0213
Brood area on frame (cm <sup>2</sup> )	600.0±17 <sup>ab</sup>	508.3±22 <sup>ab</sup>	740.6±19 <sup>a</sup>	275.0 <sup>b</sup>		338.23	0.0635
Pollen area on frame(cm <sup>2</sup> )	85.3±11 <sup>a</sup>	150.5±23.67 <sup>a</sup>	236.9±26.52 <sup>a</sup>	83.7 <sup>a</sup>		226.02	0.4389
Nectar area on frame(cm <sup>2</sup> )	660.9±21 <sup>ab</sup>	1077.3±32 <sup>ab</sup>	1396.9±36.72 <sup>a</sup>	170.3 <sup>b</sup>		1026.4	0.1054
Honey area on frame(cm <sup>2</sup> )	1408.1±25.64 <sup>ab</sup>	2058.9±32.13 <sup>a</sup>	2096.9±44.12 <sup>a</sup>	349.2 <sup>b</sup>		1382.5	0.0572

#### 4. Conclusion

From the present study, colonies consumed all types of fed, even though their rate varies. Relatively, Mung bean flour was more consumed, and the fed colony inspired more during dry season than rainy season. Based on the result it can be concluded that, Soybean flour supplement produced more internal resources like colony population, brood, pollen and honey production although its consumption was less than Mung bean. Therefore, it can be concluded that, giving pollen supplementary feeding at the time of dearth period maintains the strength of bee colony within the hive and attain to the next natural pollen and nectar flow season.

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