Journal of Animal and Veterinary Advances 6 (11): 1258-1261, 2007
ISSN: 1680-5593

The Effect of Replacement Feeding of Some Protein Sources with Pollen on Honey Bee Population and Colony Performance

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Abstract: This research was carried out with 25 off spring queens obtained from one mother queen. Twenty five sister queens breed in nucleus hives and introduce to 25 colonies. Before start bee feeding, the colonies equalized in population and honey source. Environment conditions in all colonies were same. This experiment was applied in 4 diet treatment and each treat in 5 replicates. Experimental treatment consisted of 4 base diets (pea powder, milk powder, soybean meal and collected pollen). All of diet distribute randomized between 25 colonies. Propose of this research were determined relation between nutritional effects on colonies population, honey and pollen source. After 2 month feeding with above diets, data's from this experiment was analyses. Significant different was between pea and pollen treatment with other diets ($p<0.01$). The best performance was in pea and pollen treatment; but between pea and pollen treatment wasn't significant different. The best treatments ware pea and pollen. Perhaps this performance related to decrease anti nutritional factor (anti trypsin and tannin) processes in pea powder.

Key words: Pollen, pea, protein, honey bee, anti trypsin

INTRODUCTION

One of the main purposes of each beekeeper is increasing the population of honeybee colonies because it is resulted to increasing honey production and economical efficiency.

Honeybees, like any other animal, have their own unique nutritional requirements. Necessary protein, carbohydrates, fats, vitamins and minerals are available in their natural foods, which are pollen, honey and nectar. Absence, shortage or even poor quality of pollen result in stunted growth and weight gain of young bees, reduced longevity and incomplete development of hypopharyngeal glands, leading to insufficient royal jelly production to support normal growth and development of larvae or egg production by the adult queen (Hays, 1984; Standifer *et al*., 1978).

During the shortage or complete absence of pollen, or in the presence of only poor quality pollen beekeepers, often feed colonies of honeybees with either pollen substitute (with no pollen) or supplement (with pollen) diets. These are ideally materials that provide required nutrients to bees (Safari *et al*., 2004).

Once ingested, the diet must have biological values for that particular animal or insect, be free or freed from any toxics or anti nutritional factors, have long shelf life in various conditions, be easily available and be economical (Schmidt *et al*., 1987; Herbert and Shimanuki, 1980; Wilson *et al*., 2005).

Pollen supplements or substitute can be evaluated by a variety of means, the relationships between which are often obscure. To be of nutritional value for animals and insects, the diet must be a collection of various potential feed ingredients as alternative sources of nutrition similar to their natural food sources, have proper texture and consistency and then be consumed by the animal (Herbert and Shimanuki, 1980; Schmidt *et al*., 1987; Wilson *et al*., 2005).

Shortage or poor quality of pollen in the area of experiment in this research especially in June is the main reason that made us to choose some of simple and available protein foods to feed experimental honey bee colonies. Thus the objectives of this study were determining effect of using soybean meal, pea powder and powdered milk as pollen substitution on honey bee population and colony performance.

MATERIALS AND METHODS

Preparing the place and giving number to the hives: This research was performed in Islamic Azad University Shabestar branch's research center in 2005. The hives

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were placed in a certain place which was the same for all of them. Everything was taken into account including: environment temperature, moisture, the ground, the distance between hives geographical side and other main condition. Then they were given numbers from 1 up to 25.

Generation counting: In order to measure the rate of generation, applied special method. This indicator was a framework made with waxy string and the indicator was divided comb into 80 equal parts.The distance between the parts was about one decimeter. Then every square which included egg, larva and pupa was counted.

In order to measure other factors such as honey and pollen the numbers of squares which had honey and written down. The result showed that how generation, how much honey and pollen every colonies has. Randomly then all 25 hives were divided into 5 groups. They had the same 5 treatment and each 5 replication. Out of these 5 treatments, for of them were for pollen replacements that their main basis diet was pollen, pea, milk powdered and soybean meal. The 5th treatment also had the control group. Chemical analyses showed the rate of protein, fat, carbohydrates, minerals in four main foods were plant pollen, powdered milk, pea powder and soybean meal (Table 1).

Estimating the rate of generation, the weight of honey and pollen: In order to know the generation, first one decimeter of comb was chosen with framework indicator; the number of its cells was counted and multiplied by the number of squares. Then, I had the number of its generation for every hive.

In order to calculate the weight of honey and pollen the weight of only one decimeter square of honey and pollen. In order to be exact, I used the different parts of hive and 5 of them were chosen for honey and 5 of them for pollen. Then I had the average number and this number was multiplied for every hive honey and pollen decimeter.

Pollen preparation: In order to make pollen, I used the pollen trap. Ten pollen traps were placed in front of hive entrance of 10 strong colonies other than 25 experimental colonies.

Materials used in the experiment including of honey, white sugar, pollen (gathered by pollen traps). soybean meal, white pea, powdered milk, vinegar, oxy tetracycline(preventing the growing of bacteria) and multi vitamin in order to make balance of food in terms of vitamin.

Make the first solution: First we must have the every first solution which has sugar, water, honey, vinegar and oxy tetracycline. In order to make pollen cake, first we take 100 g of the solution and mix it with 160 g of new pollen. We work with the paste until it becomes quite congenial so that it does not come out of the dishes.

Since, pea has some anti nutritional materials like tannin and anti trypsin, it needs great care and through the processes they must be disappeared.

We take some white pea; put it in a dish and same water is poured on it, them it is put on a store. When it reaches 50°C, we stop heating it, then mix it with out hands so that the skins of pea come out and water goes inside the pea, then we put the water away, we do it for 10 times the last time, after 6 h we put it in front of sun to dry. Then we grind the pea and they become powder and through powder by working it turns to paste.

Feed and measuring the rate of product: After feeding an adaptation period of 14 days, the result showed that how much they use the food. Feeding the hives with some certain materials began and they were placed inside the glass dishes on the combs of larva and pupa. When only one of the plates become empty, the others were gathered and again were put there, this was done for 8 times for 6 day. According to the remained food, the result showed that how much food they use. It is very important because it avoids them from becoming colonies ill.

Measuring with an indicator and giving the unit for measurement: Before feeding it is necessary to measure the rate of generation population. So, the generation in every hive is measured on square decimeter, since there were 39 generation (cell) in every decimeter, by multiplying it by the number of decimeters of all hives we can also have it in terms of gram through weighing them separately and multiplying it by the number of decimeters having honey and pollen in the hives. It must be said that for this first we cut one comb having honey, them only 1 cm of empty comb is cut and weighed. The difference between 2 weights comes and is divided by 2. Since, the thickness of comb is different, so different parts are used randomly. This is also used in weighing the pollen. After feeding the function of these foods on generation increasing is measured. When the indicators are put in the squares the rate of generation honey, pollen all comb etc are determined in terms of decimeter these numbers are multiplied by the units and the rate of every factor according to its unit comes.

- The number of generation in every hive = the number of decimeters per every generation × 39.
- The whole weight of honey in every hive = the number of decimeters for honey × 22.91 g.
- The whole weight of pollen in every hive= the number of decimeters for pollen × 11.825 g.

RESULTS

The population rate: According to the result of variance analysis, the number of population which was a very main factor, there was a significant difference between food treatments ($p<0.01$). According to Table 2, pollen and pea powder treatments have the least generation decline with 1271, 1295. Powders milk has 1490 and soybean meal with 1661 decline (Table 2).

The rate of honey: According to the taken, results from variance analyses, the rate of honey which was a minor factor in the experiment, we can see the significant difference ($p<0.01$).

Comparing the average effect of different food treatments on the increasing of honey, if became obvious that there is a significant difference between pollen, pea, milk powder, with the other group. Soy bean meal doesn't have any statistically effect in terms of increasing honey.

The rate of pollen: There is a significant difference between food treatments. Analysis of variance showed decline rate of pollen is minor factor. Through comparing the average, the effect of different food treatments with the existing pollen in the hive, it became obvious that there is a significant difference ($p<0.01$). There is also a significant difference between soybean meal and the treatment of other group.

Table 1: Chemical composition of experimental diets

	Components (%)				
Feeds	Crude Protein (CP)	Ether Extract (EE)	Crude Fiber (CF)	Nitrogen Free Extract (NFE)	Ash
Pollen	21.6	4.96	12.5	58	2.7
Milk powder	14	25	------	55.3	2.7
Pea powder	25.3	1.4	6.9	63.1	3.3
Soybean meal	44	1.5	7	40.2	7.3

Table 2: The result of all diet effect on colony population, honey and pollen storage

Treatment	Means of No. of honey bee reduction	Means of honey production(g)	Means of pollen reduction(g)
Control	1864^{d}	3473^{c}	113.5^{c}
Pollen	1271^{a}	4463^{a}	23.56^{a}
Pea powder	1295^{a}	4357^{a}	89.87^{b}
Milk powder	1490^{b}	3982^{b}	82.87^{ab}
Soybean meal	1661^{c}	3573^{c}	70.33^{ab}

DISCUSSION

In this experiment, pollen group have positive effect on honey bee brood area increment. Similar result was previously reported by Stephen and Robert (1999). In addition to this result, soybean meal and milk powder effect on honey bee colonies population, in line with Doug (2000).

In the current study natural pollen group was showed good performance than soy bean meal group. This result was agreement with recent researches (Malone *et al*., 2004).

According to this experiment results, pea powder experimental group have very good affect on honey bee colony population increment. This group has same effect with pollen group. In other research we cannot see this good result about pea powder on honey bee population. Previous research about pea powder was showed very little honey bee population (Herbert and Shimanuki, 1980) while in present study, pea powder group have very good performance comparable with pollen group. This effect may bee related to decrease Anti nutritional factors (tannin and anti trypsin) processes on pea powder in this research (Huisman and Jansman, 1991).

CONCLUSION

In overall conclusion, it seems that using pea powder as substitute instead of natural pollen, could be increased colony population of honey bees as same as natural pollen. Using milk powder and soybean meal were not as good as pea powder in honey bee generation increment.

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