Comparative study on improvement in Pollen Collection Technology

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Abstract

A newly designed pollen trap for beehives is disclosed. The trap includes a single wooden frame, mounted in the frame are two screens having two meshes (0.5mm in size with 0.7mm distance between them) that are fine enough to dislodge granules of pollen from the bees as they crawl through it. The pollen drops down through the screens into pollen tray. This construction permits the pollen trap to virtually occupy all the area of hive to promote good ventilation for dry pollen. The frame fits in the bottom of the hive by inserting it from back side and can be removed easily when not needed. After designing the new trap a trial was laid down on 11/02/2009 in the premises of HBRI on eight colonies. All the colonies selected were alike with respect to number of frames and bees present in them. The colonies were divided into two groups. On the first group the entrance trap was clipped while on the second group the newly devised bottom trap was fitted. The weight of pollen collected was compared and it was found to be significantly different from each other. The total yield of pollen from entrance trap and the fixed bottom trap in gm were found to be 12.55 + 1.66 (Mean ± SE) and 22.5 + 1.25 (Mean ± SE) respectively. The honey extracted from hives fitted with both types of traps was also compared and no difference was observed in their weight.

Keywords: *Pollen, Trap, Bees, Colonies.*

Introduction

Pollen, sometimes incorrectly called as flower sperm is a fine to coarse powder consisting of micro gametophyte or pollen grain which produces the male gamete of seed plant. It is bee's major source of protein, fatty substances, minerals and vitamins (Gary, 1975).

Bee pollen is the flower pollen collected by all honeybees for the purpose of feeding their larvae in the early stages of development. Collected flower pollen is accumulated as a pellet in pouches (pollen baskets) on the rear legs of the bees and it is the mixture of these pellets that comprises bee pollen (Campos *et al*., 2005). The bees mix the pollen grains with a sticky substance that is secreted from their stomach, which allows the pollen to adhere to their legs in pollen baskets in order to safely transport to their hives. Bee pollen is one of the richest and purest natural foods ever discovered, and the incredible nutritional and medicinal value of pollen has been known for centuries.

The pollen collected by bees is superior to the pollen collected directly from plants as the bees are extremely discriminate about selecting the best pollen from the millions of grains that are present, bees only select those grains that are rich in all the nutrients, especially nitrogenous materials. Traps for collecting pollen pellets from legs of honey bees have been designed to trap pollen reserves. These traps vary greatly in size, appearance, and method of installation on the hive. Incoming pollen can be sampled for studies of foraging activities of bees and for identifying and classifying pollen sources. Stored pollen is a basic ingredient of pollen supplement for feeding bees. This pollen supplement provided by the beekeeper stimulates brood rearing when the natural pollen stored in comb is unavailable or inadequate in the hive.

Pollen traps called pollen guards were first used by Farrar (1934) to prevent bees from bringing pollen into the hive. Todd and Bishop (1940) improved these guards by changing the grid from perforated metal to 5-mesh hardware cloth. For pollen identification studies Nye (1959), constructed a trap that fits underneath the hive and had an opening on the side for removing the tray filled with pollen. A trap that was inserted in the front entrance for obtaining small samples of pollen in short time was developed by Stewart and Shimanuki (1971).

Pollen traps vary greatly in design and positioning on the hive, but the basic principle is same i.e. a grid to remove the pollen from the bees and a tray to collect them.

Moisture in the pollen may be a serious problem in areas where humidity is high, so the traps should be weather proof and installed carefully to keep out moisture. Pollen should only be collected from disease free colonies and trapping should be done only during pollen flow of one quarter pound per day. During major nectar flows, pollen trapping is unprofitable as grids slow down bee activity which ultimately reduces honey production.

Freshly trapped pollen is perishable and it may be dried, frozen, or mixed with other materials and stored. For drying, the pollen should be spread on porous surface at a depth of one-half inch in an enclosed ventilated room and allow it to air dry. More rapid drying can be achieved in oven at 100 degrees F maximum. It can also be stored by putting it in paper bags in deep freezers below freezing temperatures.

Materials and Methods

The present work has been carried out in Honeybee Research Institute, National Agricultural Research Centre Islamabad, Pakistan during February-March 2009. We went under a series of steps before designing a new type of trap for collection of pollen from standard deep bottom hives. Initially, a double screen grid with a distance of 1.7mm was made (design no.1) but it did not proved to be effective as it disturbed the movement of bees from one screen to other and ultimately we did not collect any pollen. Then it was improved by removing one mesh from it (design no. 2). When this trap was checked the objections from the first designed pollen trap were removed but another serious problem arouse i.e. time consumption in the installation, as every time we have to remove the top covers of hive while inserting the pollen trap, which is not economical in terms of time spent by beekeeper on other management practices especially in spring season.

The design and location of the pollen trap on the hive may be changed to meet the prevailing needs and climatic conditions. Ease of installation, colony manipulation, minimum disturbance, cleanliness of pollen and size of tray should be given special attention while designing any trap. Thus keeping in view the above mentioned facts a further change was made in the trap (design no. 2) by making the grid which fits permanently in the hive and to collect pollen, just insert the single mesh (metal/plastic as both proved effective) which fits into that grid and when not needed can be removed easily.

The design of no. 2 trap was further modified by using double mesh screen and keeping the distance of 0.7mm between them. Finally, the structure of pollen trap was made strong by using fine wood of *Pinus walluchiana* and inserting it from the back side so that it will not cause any hindrance to the incoming bees. Thus, the bees enter the hive through an opening at the front of hive and while passing through the mesh grid, most of the pollen pellets dislodged from the hind legs of the returning bees, fall into a tray covered by screen that allows the pollen pellets but not the bees to pass. The size of holes is also a crucial factor as it must not damage bees or restrict their normal flight activity. It is hoped that this new design of pollen trap produces reliable, consistent results and overcomes some of the problems encountered with other designs of traps.

Pollen Collection

After designing the new trap a trial was laid down on 11/02/2009 in the premises of HBRI on eight colonies. All the colonies selected were alike with respect to number of frames and bees present in them. The colonies were divided into two groups. One group of four colonies had the entrance trap fitted at the entrance and on other four the newly devised bottom trap was fixed.

Each trap was fixed on the hives at 10am and removed at 2pm. The experiment was continued for three weeks and data was taken twice a week. The pollen collected each day was stored in plastic bottles and weighed.

A total of 40 samples of pollen were collected from the hives by using pollen trap in front of the hive for 4hrs interval throughout the experiment. These pollen samples were removed from the hind legs of honeybees on a rack fitted in a tray inside the trap, as bees pass through the trap, the loads on their legs fell down. After 4hrs interval traps were removed and pollen loads were collected, weighed and spread on the clean white paper for sorting. The pollen of different colour was stored in small glass bottles.

A field survey was conducted and bees with pollen loads on their legs were collected from different plants. The pollen loads were then pushed off the hind legs into individual specimen of polythene bag. The bees were released unharmed or sometimes killed by using the killer bottle. These colours were matched with those pollen pellet trapped by pollen traps, which helped in identifying the source of pollen.

Results and Discussion

To analyze our data we used SPSS statistical programme version fourteen in which the approach is rather different as the statistics are not displayed on the spread sheet but in separate windows. Comparisons between means were made using the least significant difference (LSD) at 0.05 probabilities (SPSS). For statistical data, standard descriptive statistics were performed for each of the quantitative parameters.

The dependence of honeybees on pollen in several ways is well documented (Stanley and Linskens, 1974, Wille *et al.,* 1985). Pollen is used primarily as a source of essential aminoacids required by honeybees (De Groot, 1953) in protein synthesis. In our study we worked on the newly devised pollen trap fitted on *Apis mellifera* colonies. The brood rearing capacity of *Apis mellifera* is known to be improved by the addition of pollen ash to a chemically defined diet (Herbert and Shimanuki, 1978). The nutritional status and biochemical composition of the royal jelly as influenced to a large extent by the type of pollen nutrition (Stanley and Linskens, 1974), may affect the composition of food fed to honeybee larvae.

The use of pollen trap in pollen studies is not a new phenomenon. Wille *et al.,* (1985) reported that the weight of pollen collected by a colony, calculated from amounts collected in pollen traps, varies from 10 to 25kg/year. The mean weight of pollen collected from the entrance clipped pollen trap ranged from 0.5 to 49.0 gm and for the newly devised fixed bottom trap the range was 6 to 45gm respectively. The Lavene's Test for equality of variance showed the P value greater than 0.05 so the weight of pollen collected was compared by using non parametric Mann-Whitney U Test and it was found that they were significantly different from each other (Mann-Whitney U = 512.5, $P < 0.00$). The total mean yield of pollen (gm) from entrance trap and the fixed bottom trap were found to be 12.55 ± 1.66 (Mean $\pm$ SE) and 22.5 ± 1.25 (Mean $\pm$ SE) respectively (Fig. 1).

The pollen brought in by the bees at Rothamsted during 1945 and 1946 has been collected daily by using a newly designed pollen trap and it was found that legumes, rosaceae trees/ shrubs and forest trees share 54, 15 and 11 % of the total collected pollen (Synge, 1947). Cundill (1986) tested a simple trap at three locations in Scotland and collected data at monthly intervals for three years which showed a clear link between pollen and the dominant plant species of the area. In our study after matching the colour of pollen colleted from trapped bees while foraging plants with that of pollen collected in pollen traps also showed a positive relationship between the pollen and prominent botanical sources of the area around the experimental trial. The results obtained also show some important pollen colours as follows;

Plant	Pollen load colour
Sillibum Sp.	Sea green
Lallemantia royleana	Green
Brassica compestris	Bright yellow
Calendula arvensis	Orange
Callestemon citrinus	Yellowish green
Citrus sativa	Light orange
Corrinadrum sativum	Grayish white
Grewia asiatica	Off white
Justica adhatoda	Off white
Prunus persica	Light orange
Rosa indica	Yellow
Trifolium alexandrianum	Brown
Eucalyptus cammoldulensis	Yellowish green
Taraxacum officinale	Bright yellow
Linum usitatissimum	Dirty green
Prunus armeniaca	Greenish white
Raphanus sativus	Yellow
Euphorbia Sp.	Reddish yellow

The colour of pollen can help in identifying the plants present in the area (Kirk, 1994). This method is usually accurate and can often identify the pollen to genus and species level but it is time consuming and requires expertise.

In order to evaluate the use of three different types of traps referred as entrance, bottom and board, an investigation carried out in Poland (Bobrzecki and Wilde, 1987) showed that total pollen collected in 1986 was 2.47, 0.69 and 0.70 kg respectively for bottom, entrance and board traps. In 1987 the corresponding figures were 1.58, 0.50 and 0.41kg. They also found that amount of pollen did not lower the amount of honey produced which is in agreement with our results as we also did not find any difference in the amount of honey harvested from hives fitted with different traps (One Way ANOVA, $F_{(1, 7)} = 16.59$, $P > 0.001$). The mean weights of honey (kgs) produced from colonies fitted with front and fixed bottom trap were 10.43 $\pm$ 2.51 (Mean $\pm$ SE) and 8.51 $\pm$ 1.39 (Mean $\pm$ SE) respectively (Fig. 2).

Pollen traps have been used extensively by the various beekeepers during the summer months to collect surplus pollen brought in by the bees which can be used in the following spring to stimulate brood rearing at a time when pollen is in short supply.

Stephen and Robert (2001) indicated that honeybees respond to deficiencies in the quantity or quality of their pollen reserves by increasing the gross amount of pollen returned to the colony, rather than by specializing in collecting pollen with greater pollen content.

They also suggested that colonies may respond to changes in their pollen stores by adjusting the numbers of inexperienced to experienced foragers within their foraging populations.

The newly designed trap used in our study does not fit at the existing entrance but is placed at the bottom of the hive which allows the bees to have easy free access without getting crowded or aggressive. This ensures that they can replenish or collect their own pollen stores in good quantity. This trap is designed for beekeepers to allow them to keep the trap on the hive throughout the summer and collect the pollen on alternate weeks or after every 2-3 days of week without disturbing bees and avoiding labour of putting and removing traps every time. The surplus pollen should be collected every other day and stored properly as a byproduct for feeding colonies when required.

However, this requires more critical evaluation by future experiments involving collection of pollen over several months from single and mixed plant populations.

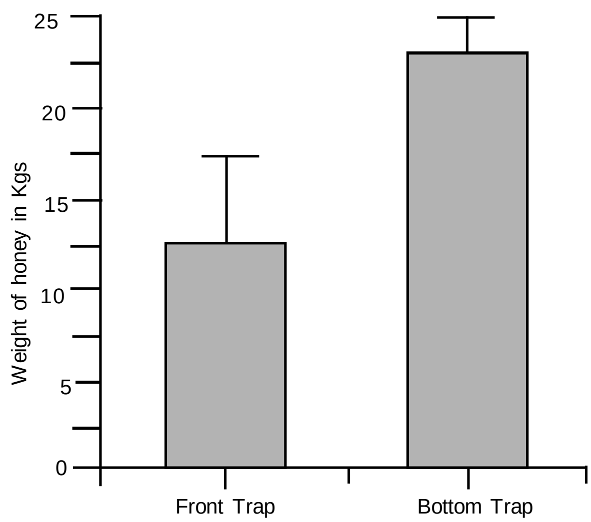

Fig. 1: The weight of pollen collected from the entrance fitted pollen trap (T1) and newly devised fixed bottom trap (T2).

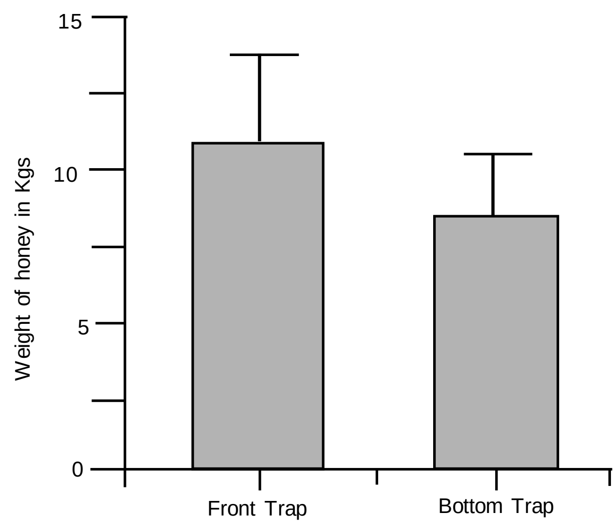

Fig. 2: The weight of honey harvested from hives fitted with front and newly devised fixed bottom pollen trap.

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