Pollen Trapping Honey Bee Colonies in Minnesota

PART I: Effect on Amount of Pollen Trapped, Brood Reared, Winter Survival, Queen Longevity, and Adult Bee Population.[1,2,3]

by S. R. DUFF and B. FURGALA
Department of Entomology
University of Minnesota, St. Paul, Minnesota 55108

Slightly Revised Manuscript Received for Publication Aug. 4, 1986

ABSTRACT

Four (4) experimental pollen trapping treatments (full-time, part-time, no-time, and control) were used to determine how pollen trapping affects honey bee colonies. The effect of pollen traps on several colony characteristics was measured. There were no significant differences in winter survival or queen longevity. More pollen was trapped per day from the part-time treatment than the full-time treatment in both 1984 and 1985. The full-time treatment colonies had significantly less brood than did the other 3 treatments in late summer of 1984, and in May, 1985. The full-time treatment also had significantly less brood than the no-time treatment in early spring of 1985. The full-time treatment had significantly fewer adult bees than the part-time or control treatments at the end of the experiment.

INTRODUCTION

BEEKEEPERS have been using devices to trap plant pollen for many years, and the effects of such pollen trapping on honey bee colonies have been studied by a number of investigators. Differences in location, duration, and experimental design have led to contradictory results.

Lavie (1967) and McLellan (1974) reported that pollen trapping had no significant effect on the amount of brood reared. Ibrahim and Selim (1974) and Moeller (1977), however, reported that continuous pollen trapping reduced the amount of brood reared.

McLellan (1974) reported a slight reduction in winter survival of colonies being trapped, but advocated that further studies were needed. Moeller (1977) found that winter survival of colonies that had been pollen trapped was seriously affected. He recommended that colonies not be trapped for prolonged periods.

McLellan (1974) found that colonies with traps had adult populations that were similar to untrapped control colonies except for a slight population reduction in August.

Thus, the debate continues on whether the use of pollen traps is detrimental to colonies, and if pollen trapping is profitable to beekeepers. Since the use of pollen traps on honey bee colonies has increased over the past few years, this study was conducted to determine the effects of pollen trapping in east central Minnesota.

MATERIALS AND METHODS

This study was initiated in May 1984 and was terminated in October 1985. It was designed to evaluate the effects of pollen trapping on honey bee colonies managed in a 2-year system. This management system used young queens and divisions during the first year and overwintered strong parent colonies during the second year. The management of colonies in this experiment was similar to that used by Sugden and Furgala (1983).

The bottom type trap selected was modeled after the original OAC trap developed by Smith and Adie (1963. This pollen trap (Honeybee Products, Rt. 1, Amery, WI 54001) is available commercially (Fig. 1).

On May 15, 1984, 28 queenless divisions were prepared. Each division contained approximately 5100 sq cm of brood and adhering adult honey bees in a standard Langstroth hive body. Clipped and marked Starline queens purchased from the same commercial source were introduced and established in the divisions. The details for making divisions and installing queens were described by Sugden and Furgala (1982, 1983). On May 31, 1985, 24 queenright divisions were moved to a University of Minnesota St. Paul Campus apiary.

Four (4) experimental pollen trapping treatments were used. The first treatment represented full-time trapping (FT). The colonies in this treatment were trapped from June 1 until frost the first season and from April 9 until frost the second season. The second treatment involved part-time trapping (PT). This treatment consisted of trapping pollen every other week. The trapping grids of the pollen trap could be disengaged to allow free movement of the bees on alternate weeks (Fig. 1). The third treatment was no-time trapping (NT). The colonies in this treatment were placed over pollen traps, but the grids were always disengaged to allow the bees unimpeded access into the hive. The fourth treatment was the control (C). Colonies in this treatment were not equipped with pollen traps.

The experiment was a complete randomized block with 3 circles of colonies. Treatments were randomly assigned to colonies with the restriction that each circle contained 2 colonies from each treatment (Fig. 2). The circular arrangement was used to reduced drift among colonies. All data were collected from the colonies at random. No data were collected from a colony after a supersedure or queen loss, but the colony remained in position for the duration of the experiment.

---

[1] Published as paper No. 14,970 of the Scientific Journal Series of the Minn. Agric. Expt. Station on research conducted under Minn. Agric. Expt. Station Project No. MIN-17-023.

[2] Reference to proprietary products or company names is made with the understanding that no discrimination is intended and no endorsement by the Univ. of Minn. is implied.

[3] This study was supported, in part, by the Minnesota Honey Producers Association.

The pollen trapped from the FT and PT treatments was collected twice weekly throughout the experiment. The pollen from each colony was placed in a paper bag and the fresh weight determined and recorded.

About 3 weeks after the experiment was set up (June 19, 1984), the brood area of each colony was measured. Queen longevity was determined by locating the clipped and marked queens during this brood count and subsequent counts. After this initial brood count was completed, a third full depth hive body containing empty comb was added to each colony.

Throughout the summer each colony was provided with additional space to accommodate the incoming nectar and the accumulation of honey. After the main nectar flow (August 27, 1984) another brood count was taken.

The pollen traps were removed after the first frost in the fall (September 25, 1984). Each colony was fed 8 liters of 2:1 sugar syrup containing 200 mg fumagillin activity. Colonies were weighed with a spring scale (Model No. 8920/ Hanson Scale Co., Shubuta, MS 39360) to ensure that they had ample stores for the winter. On October 26, 1984, an insulite board was laid over the inner cover and a commercial packing case (Dadant & Sons, Inc., Hamilton, IL 62341) placed over each hive. The bottom entrance was reduced and an upper entrance provided (2.54 cm auger hole) (Fig. 3).

The colonies were not disturbed until February 27, 1985. At that time each colony was given a 450 gm pollen substitute patty consisting of Torutein (Pure Culture Products, Hercules Inc., Wilmington, DE 19894) and honey. Three (3) weeks later an additional 225 gm patty was given to each colony.

In early April, shortly after natural pollen was available, the pollen traps were placed under the colonies for the second season. An early spring brood count was taken on April 10, 1985.

On May 7, 1985 another brood count was taken and each colony divided by removing 5100 sq cm of brood from each colony. The queen and remaining brood were left in 2 full depth hive bodies. After allowing 24 hours for flyback, the experimental parent colonies were transported to the University of Minnesota Agricultural Experiment Station at Rosemount. Each colony was provided with 2 medium depth honey supers with drawn comb to accommodate surplus dandelion nectar. The brood chambers of the parent colonies were reversed regularly prior to the main nectar flow to relieve congestion and prevent swarming.

During the summer, medium depth supers with light drawn comb were provided for additional nectar space. A final brood count was taken (September 18, 1985) before the experiment was terminated.

On October 5, 1985, the adult bees in each colony were killed and their weight determined.

The mean amount of pollen trapped, mean brood area, and mean weight of the adult population were computed for the pollen trapping treatments. Data were subjected to 2-way analysis of variance. The Student-Newman-Keuls' procedure was used to determine significance of differences among means. Chi-square analysis was used to determine whether winter survival or queen longevity differed among treatments.

RESULTS AND DISCUSSION

More pollen was trapped per day from PT treatment colonies than from FT treatment colonies in both 1984 and 1985 (Table 1). The amount of pollen trapped per day from the FT treatment colonies exceeded the amount from the PT treatment colonies during only 2 of 10 months of trapping over the 2 seasons (Fig. 4). Although the differences between the FT and PT treatments were consistent both years, they were not significant ($p > 0.05$).

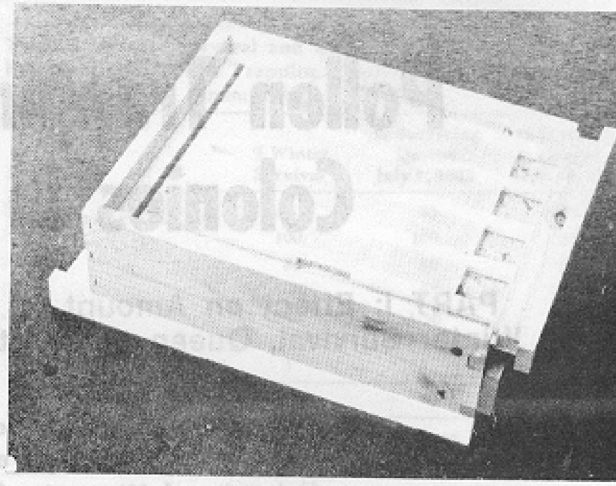

Figure 1. The pollen trap used in the experiment.

Figure 2. One of the circles containing 8 colonies, during the main nectar flow at St. Paul in 1984.

Figure 3. One of the circles prepared for winter.

The 4 treatments used in this study provided some significant insights on how pollen trapping affects honey bee colonies. The pollen traps affected colonies in 2 ways. The continuous use of pollen traps as in the FT treatment reduced pollen intake and the trapping grids formed a mechanical barrier to foraging activity. The PT treatment had both of these restrictions, but for only half the time. The reduced amount of pollen trapped by the FT treatment may have been due to fewer foragers (Duff and Furgala, 1986), or the FT treatment foragers may have developed increased skills to get more pollen through the traps. The NT treatment with traps underneath did not trap pollen.

The traps in this treatment formed a partial barrier, but the bees were not forced through the metal grids. The C treatment had no restrictions, and also had auger holes in all hive bodies providing additional entrances.

The brood areas measured at various intervals during both years are shown in Table 2. No significant differences in brood area were evident in the initial count ($p>0.05$). At that time it was determined that all queens were present and laying.

In August after the main nectar flow, the FT colonies contained significantly less brood than did the other 3 treatments (<0.05). A reduction in pollen intake by this treatment may have forced the bees to cut back on brood production.

In 1985 the FT treatment had the least brood area during the early spring brood count, significantly less brood than did the NT treatment ($p<0.05$). On May 7, when the divisions were made, the FT treatment had significantly less brood than the other 3 treatments.

The reduced brood area found in the FT colonies in May was particularly significant to our management system. Each wintering unit must provide a division with at least 5100 sq cm of brood at this time. All colonies that had wintered were judged to be divisible on May 7. Colonies that had lesser amounts of brood were left as weaker parent colonies after the divisions were removed.

No significant differences were observed among PT, NT, and C treatments when the final brood count was taken ($p>0.05$). The FT treatment had the least brood area at this time. The FT treatment was not included in the analysis, however, since late supersedures after the nectar flow reduced the number of experimental colonies with original queens.

More study is necessary to determine why the area of brood was reduced in the FT treatment. It is possible that the reduced amount of pollen available for colony use affected the brood area. Brood cannibalism, as reported by Weiss (1984), may play a part, as could reduced ventilation due to the traps.

The differences in brood areas between the FT and the PT treatments seem to correspond to the lower amounts of pollen trapped from the FT colonies. Free (1967) studied the effect of brood on pollen collection by examining returning foragers. He found that bees collected more pollen when the amount of brood in a colony was great, and less pollen when there was little brood or when a colony was queenless. Moeller (1977) reported that colonies that were supplemented with frames of young brood had increased pollen yields. In our experiment brood rearing was reduced in the FT treatment, but from our data we could not determine whether a pollen shortage decreased brood area, less brood reduced pollen collection, or if a combination of both factors existed.

Only one colony failed to survive the winter. A chi-square analysis of wintering showed that no differences were apparent among the treatments ($p>0.25$). McLellan (1974) and Moeller (1977) had found some difficulty in wintering colonies that had been trapped. We left all colonies with

Table 1. Mean Weight of Pollen Trapped from Colonies Representing 2 Pollen Trapping Treatments, St. Paul and Rosemount, MN, 1984-1985.

	Pollen Trapped/Day (gms)						
	1984						
Treatment			June	July	Aug.	Sept.	All Year[1]
Full-time (FT)			57.4	29.3	53.4	25.1	40.8 ± 6.3 a
Part-time (PT)			67.9	43.3	57.5	36.9	55.2 ± 8.4 a
	1985						
	Apr.	May	June	July	Aug.	Sept.	All Year[1]
FT	35.1	79.4	62.8	25.5	79.6	31.0	52.5 ± 8.6 a
PT	83.2	70.6	99.1	50.8	93.1	17.9	71.4 ± 12.0 a

[1] Mean ± Standard error ($n = 6$).

Means for each year followed by different letters are significantly different using Student-Newman-Keuls' mean separation ($p \leq 0.05$).

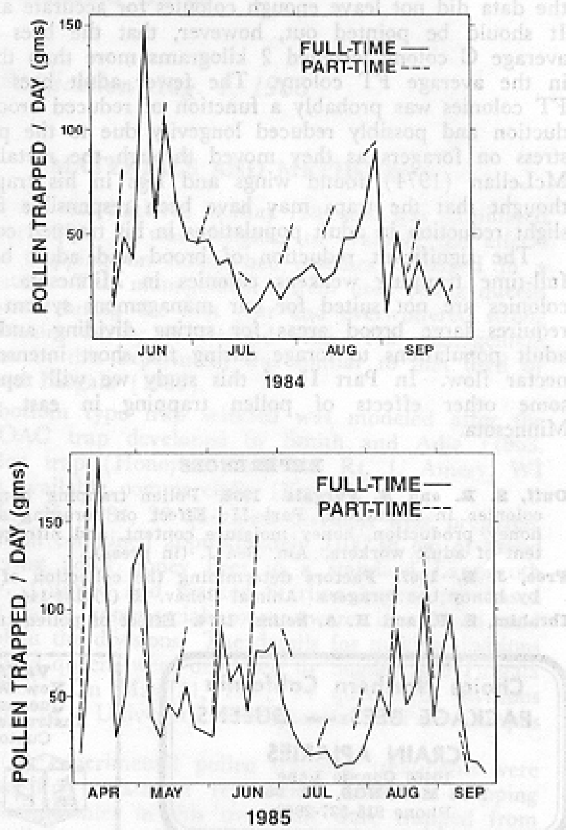

Figure 4. The amount of pollen trapped per day from the full-time and part-time treatments in 1984 and 1985.

Table 2. Mean Brood Area in Colonies Representing 4 Pollen Trapping Treatments, St. Paul and Rosemount, MN, 1984-1985.

	Brood Area (sq. cm.)[1]				
	1984		1985		
Treatment	June 19	Aug. 27	Apr. 10	May 7	Sept. 18
Full-time (FT)	8394 ± 792 a	6113 ± 689 a	2822 ± 271 a	9605 ± 799 a	542 ± 510 *
Part-time (PT)	9109 ± 644 a	9134 ± 631 b	3556 ± 238 ab	12581 ± 953 b	2770 ± 264 a
No-time (NT)	9321 ± 296 a	7807 ± 309 b	4915 ± 715 b	13618 ± 419 b	1836 ± 354 a
Control (C)	10088 ± 329 a	8645 ± 496 b	3814 ± 406 ab	13231 ± 1024 b	2808 ± 419 a

[1] Mean ± Standard error ($n = 6$).

Means for each date followed by different letters are significantly different using Student-Newman-Keuls' mean separation ($p \leq 0.05$).

* Supersedures in this treatment prevented accurate analysis.

more than adequate honey stores (a minimum of 85 kilograms gross weight) and in a disease-free condition which probably prevented unacceptable losses (Table 3).

The Starline queens used in the experiment performed quite well. No significant differences ($p>0.10$) among treatments were observed in queen longevity throughout the experiment (Table 3). The late supersedures in the FT treatment did not concern us. In our management system the loss of queens after the nectar flow in the second season is not critical. However, it may be of concern to others who attempt to winter colonies a second season with the same queen.

The weights of adult bees in the colonies at the end of the experiment are presented in Table 4. The FT treatment colonies contained significantly fewer bees than did the PT and C treatment colonies ($p<0.05$). Weights of adult bees from colonies that had superseded late in the season were included in the analysis. The weights from the NT treatment were not compared since the missing values in the data did not leave enough colonies for accurate analysis. It should be pointed out, however, that the bees in the average C colony weighed 2 kilograms more than the bees in the average FT colony. The fewer adult bees in the FT colonies was probably a function of reduced brood production and possibly reduced longevity due to the physical stress on foragers as they moved through the metal grids. McLellan (1974) found wings and legs in his traps and thought that the traps may have been responsible for the slight reduction in adult populations in his trapped colonies.

The significant reduction of brood and adult bees by full-time trapping weakens colonies in Minnesota. Weak colonies are not suited for our management system which requires large brood areas for spring dividing and large adult populations to forage during the short intense main nectar flow. In Part II of this study we will report on some other effects of pollen trapping in east central Minnesota.

Table 3. Winter Survival and Longevity of Queens in Colonies Representing 4 Pollen Trapping Treatments, St. Paul and Rosemount, MN, 1984-1985.

Treatment	% Winter Survival	% Surviving Queens July 1, 1985	% Surviving Queens Sept. 18, 1985
FT	100	83	33
PT	100	100	83
NT	83	66	66
C	100	83	83
chi-square	3.13 ($p>0.25$)	4.50 ($p>0.10$)	2.40 ($p>0.25$)
degrees of freedom	3	3	3

Table 4. Mean Weight of Adult Honey Bees in Colonies Representing 4 Pollen Trapping Treatments, Rosemount, MN, 1985.

Treatment	Wt. of Bees (gms)[1]
FT	2545.4 ± 70.9 a
PT	4024.9 ± 303.3 b
NT	3482.6 ± 522.5 *
C	4810.1 ± 209.8 b

[1] Mean ± Standard error (n = 6).
Means followed by different letters are significantly different using Student-Newman-Keuls' mean separation ($p \leq 0.05$).
* Missing values in this treatment prevented accurate analysis.

REFERENCES

Duff, S. R. and B. Furgala. 1986. Pollen trapping honey bee colonies in Minnesota, Part II: Effect on foraging activity, honey production, honey moisture content, and nitrogen content of adult workers. Am. Bee J. (in press).

Free, J. B. 1967. Factors determining the collection of pollen by honey bee foragers. Animal Behav. 15 (1):134-144.

Ibrahim, S. H. and H. A. Selim. 1974. Effect of pollen traps on honey bee colonies. Agric. Res. Rev., Cairo, Egypt. 25:109-114.

Lavie, P. 1967. The effect of using pollen traps on the honey yield of bees colonies. (In French). Annls. Abeille 10 (2):83-95.

McLellan, A. R. 1974. Some effects of pollen traps on colonies of honey bees. J. Apic. Res. 13:143-148.

Moeller, F. E. 1977. Managing colonies for pollen production. Proc. XXVI Int'l. Apic. Congr. 232-239.

Smith, M. V. and A. Adie. 1963. A new design in pollen traps. Can. Bee J. 74 (4):4-5, 8.

Sugden, M. A. and B. Furgala. 1982. Evaluation of six commercial honey bee (**Apis mellifera** L.) stocks used in Minnesota Part I — wintering ability and queen longevity. Am. Bee J. 122 (2):105-109.

__________, 1983. Starline queens from eight commercial sources evaluated in Minnesota. Am. Bee J. 123 (10):701-704.

Weiss, K. 1984. Regulation of the protein balance in the bee colony (**Apis mellifera** L.) by brood canibalism. (In German). Apidologie 15 (3):339-354.