Pollen Trapping Honey Bee Colonies in Minnesota

Part II: Effect on Foraging Activity, Honey Production, Honey Moisture Content, and Nitrogen Content of Adult Workers[1,2,3]

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ABSTRACT

Four (4) experimental pollen trapping treatments (full-time, part-time, no-time, and control) were developed to determine how pollen trapping affects honey bee colonies. The effect of pollen traps on several colony characteristics was measured. The full-time, part-time, and no-time treatments had significantly fewer returning foragers than did the control treatment in 1984. The full-time treatment had significantly fewer returning foragers than the other 3 treatments in 1985. The honey production of the full-time treatment was significantly less than that of the control treatment in 1984. In 1985 honey production differed significantly among treatments. The full-time treatment had the lowest honey production. The honey moisture contents of the full-time and part-time treatments were elevated in 1985.

INTRODUCTION

IN PART I we reported that pollen trapping regimes affected the amount of pollen trapped, brood production, and adult populations (Duff and Furgala, 1986). In this report we will discuss the effect of our pollen trapping regimes on foraging activity, honey production, honey moisture content, and nitrogen content of adult workers.

Levin and Loper (1984) studied the effect of pollen trapping on the activity of foraging bees. They reported that traps did not affect the number of bees leaving a colony. Both Levin and Loper (1984) and Rybakov (1961) reported, however, that foraging populations from colonies with pollen traps have a higher percentage of pollen collectors.

The level of efficiency that pollen traps remove pollen from returning foragers was measured by Levin and Loper (1984). They discussed factors that affected the efficiency of pollen traps.

Reports concerning the effect of pollen traps on honey production have varied. Hirshfelder (1951) and Lavie (1967) found that honey yields were reduced due to the presence of traps. McLellan (1974) on the other hand found that pollen trapping had no significant effect on the amount of honey stored. Rybakov (1961) reported an increase in honey yields from trapped colonies.

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[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.

MATERIALS AND METHODS

The experimental design, treatments, and management system used in this study were described in Part I (Duff and Furgala, 1986).

The foraging activity of all colonies was measured using a technique described by Sugden and Furgala (1982). All entrances were blocked for 60 seconds and the returning foragers were photographed at the colony entrance with a 35 mm camera (55 mm lens). The processed slides were projected and the individual bees counted. Photographs were taken during the seasonal nectar flows, 3 times in 1984 and 4 times in 1985. To reduce variation, the photographs were taken between 10:00 a.m. and 2:00 p.m. CST on sunny days (Fig. 1).

Samples of returning foragers were collected with a sweep net in 1985 (Aug. 6, Aug. 26). The bees were killed and later examined for pollen loads. The percentage of pollen collectors was calculated for each colony for both sample dates.

Honey production was measured both seasons by a technique similar to one used by Sugden and Furgala (1983). Each colony was weighed with a spring scale (Model No. 8920/Hanson Scale Co., Shubuta, MS 39360) before and after the main nectar flow. The weight gain was determined by subtracting the post-flow weight from the pre-flow weight and adjusting the difference to account for the wood and wax of the added honey supers (Fig. 2).

In 1985 the surplus honey from each colony was harvested separately, extracted by treatment, and stored in separate containers. After the honey had cooled and settled, 10 honey samples from each treatment were taken and the moisture content of each sample measured with a honey refractometer.

Percent total nitrogen content of the adult bees was determined at 3 different times during the experiment (October 17, 1984, May 1, 1985, June 26, 1985). Three (3) 50 adult bee samples from each colony were collected from the top hive body. The bees were placed in vials and frozen. Percent nitrogen content of each sample was then determined by the Kjeldahl procedure (Research Analytical Laboratory, University of Minnesota).

The mean number of returning foragers per minute, mean honey production per colony, and mean percent nitrogen content of adult bees were calculated for all of the treatments. Data were subjected to 2-way analysis of variance and the significance of differences among treatment means determined using the Student-Newman-Keuls' mean separation procedure.

RESULTS AND DISCUSSION

In 1984 the full-time (FT), part-time (PT), and no-time (NT) treatment colonies had significantly fewer returning foragers than did the control (C) treatment colonies ($p<0.05$) (Table 1). In 1985 the FT treatment had significantly fewer returning foragers than did the other 3 treatments ($p<0.05$). The fact that during the first season there was a significant reduction in the number of returning foragers indicated that, although the brood and populations were similar (Duff and Furgala, 1986), the traps were likely acting as barriers and preventing maximum bee flight. In 1985, after the trapping regime had been in place for a longer period, we found that the FT treatment had significantly fewer returning foragers than the other 3 treatments ($p<0.05$). This probably was a function of both the smaller populations (Duff and Furgala, 1986) and the mechanical barrier presented by the pollen traps.

The efficiencies of the pollen traps were found to be quite variable. Preliminary data indicated that the trap efficiency varied from 30 to 70 per cent (unpublished data). This corroborates the results reported by Levin and Loper (1984), who found that efficiencies of traps were not constant.

The percentage of pollen collectors in the foraging populations did not increase in the FT or the PT treatments (Table 1). However, the presence of the traps in the NT treatment increased the percentage of pollen collectors significantly ($p<0.05$). These data do not support the findings of Levin and Loper (1984) and Rybakov (1961).

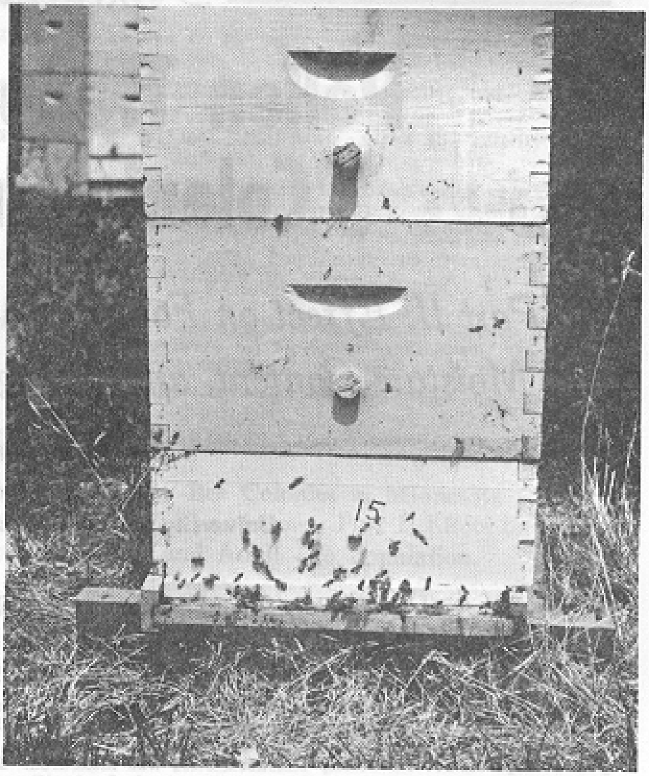

Figure 1. Returning foragers were photographed after blocking colony entrance for 60 seconds.

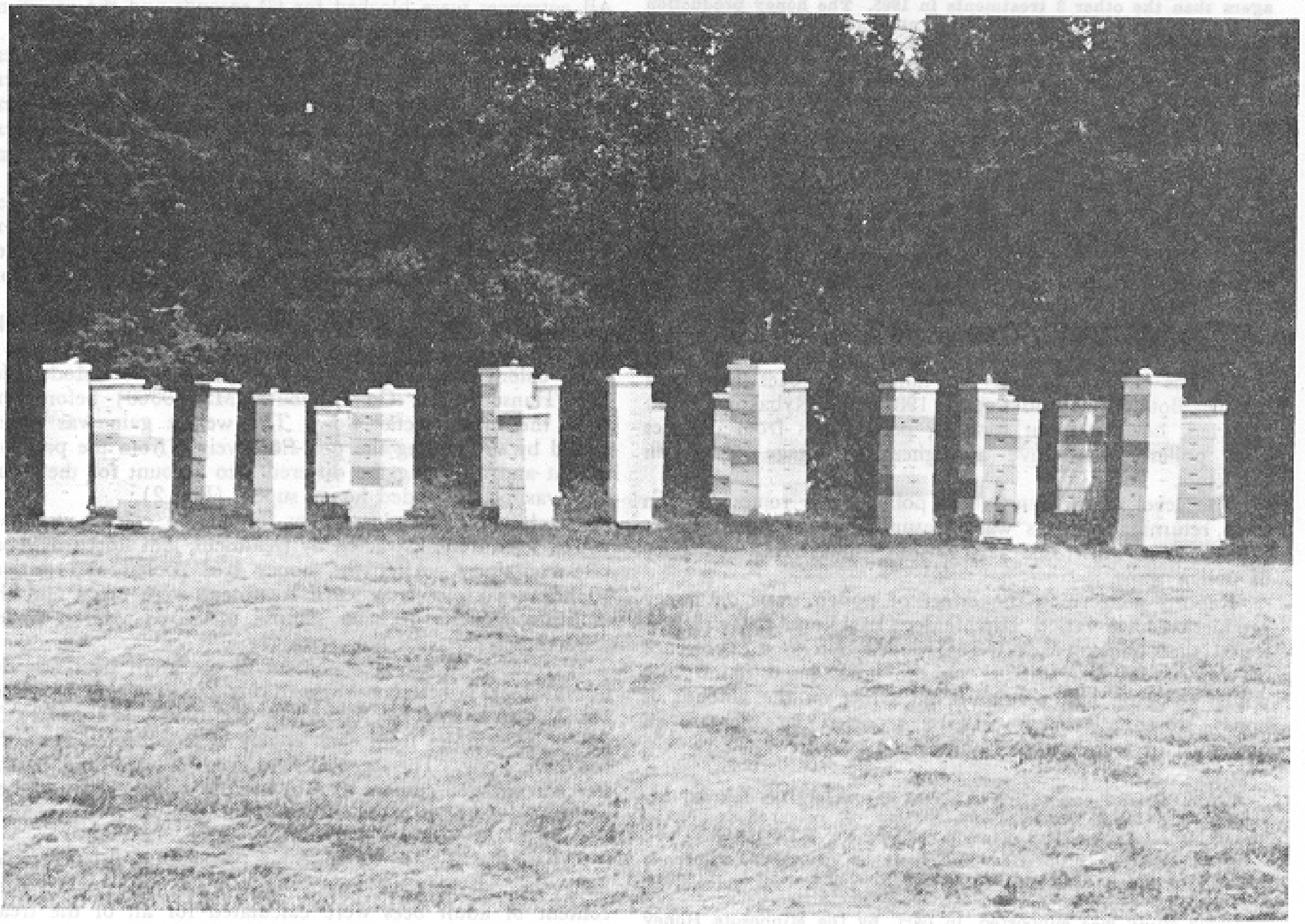
Figure 2. The colonies during the main nectar flow at Rosemount in 1985.

The honey production data for both 1984 and 1985 are presented in Table 2. Production from the FT treatment colonies was significantly lower ($p<0.05$) than that of the C treatment colonies in 1984. The reduction in productivity corresponded to the reduction in the number of returning foragers. Reduced honey production in 1984 was important since this effect was measured during the main nectar flow, which began just one month after the traps had been installed. The weight gains of colonies shown for 1984 do not reflect the amount of surplus honey, since considerable stores were left in the 3 hive bodies for winter feed.

In 1985, mean honey production of all 4 treatments differed significantly ($p<0.05$) (Table 2). The colonies in the C treatment exhibited the greatest weight gains, followed by the NT treatment, and the PT treatment. The colonies in the FT treatment produced the least weight gains during the main nectar flow. The reduction in honey production of the FT treatment in 1985 paralleled the reduction in amount of pollen trapped, brood area, and adult bees (Duff and Furgala, 1986) and also the fewer returning foragers ($p<0.05$) (Table 1).

Honey production during the second season is generally more important to our management system. Overwintered colonies are more populous than first year divisions and usually produce the majority of our honey. However, in 1985 the nectar flows at the University of Minnesota Agricultural Experiment Station at Rosemount were below average due to the very dry conditions.

The moisture content of the honey was not determined in 1984. The honey from all of the treatments was pooled after the weights had been determined. A high moisture content of this pooled lot of honey suggested that pollen traps may have a negative effect on honey quality. For this reason we measured moisture content in 1985 and found that in addition to the reduction in quantity of honey, there was also a reduction in quality due to pollen traps. Honey moisture content of each treatment increased with each level of trapping (Table 3). The FT treatment had the highest moisture content followed by the PT treatment. The moisture contents of these 2 treatments exceeded 18.6 percent and did not meet the federal grading standards for U.S. Grade A honey. The honey moisture contents of the NT and C treatments were acceptable.

The increase in moisture content was due to the inability of the bees to evaporate the excess moisture in both the FT and PT treatment colonies. This inability to evaporate excess moisture may have been due to a lack of ventilation, the reduced number of bees in the trapped treatment colonies, or both. This problem can be very important to honey producers who pollen trap a large percentage of their colonies, and to hobbyists who may not realize that the product they remove from their colonies may not conform to federal grading standards. It may be prudent to remove traps prior to harvest to allow the bees time to evaporate the excess moisture.

Percent nitrogen content of adult bees was determined on 3 dates during the study (Table 4). In the fall of 1984, the adult bees from the NT treatment were found to have a significantly higher ($p<0.05$) percentage of nitrogen in their bodies than did the adult bees from the C treatment. In 1985 no differences were found among any of the treatments ($p>0.05$).

The nitrogen content of the adult honey bees was determined in an attempt to measure an effect on individual bees that may have resulted from a reduced pollen intake or change in activity. Haydak (1937) reported that a pollen-free diet reduced the nitrogen content of adult bees. Weiss (1984) found that brood cannibalism may play a part in maintaining the protein balance of a colony. We did not show a reduction in percent nitrogen for any of the trapping treatments at any time. The one difference we found in 1984 may have been due to increased activity (brood production, returning foragers) in the C treatment.

In summary, we have shown that full-time pollen trapping of honey bee colonies in Minnesota has a detrimental effect on brood production, adult bee populations, (Duff and Furgala, 1986) forager activity, honey production, and the moisture content of the honey. Colonies trapped part-time are not as seriously affected, but foraging activity and honey production are reduced and the moisture content of honey is elevated. Even the presence of a disengaged trap affected foraging activity and honey production.

Our results indicate that under upper Midwest conditions full-time pollen trapping should be avoided. The pollen collected must be of more value than both the reduction in honey production and the additional labor and expense needed for pollen trapping and handling. If beekeepers must collect pollen, a part-time schedule would seem appropriate.

Table 1. Mean Number of Foragers Returning per Minute and the Percentage of Pollen Collectors from Colonies Representing 4 Pollen Trapping Treatments, St. Paul and Rosemount, MN, 1984-1985.

Treatment	Returning Foragers[1] per Minute 1984	Returning Foragers[1] per Minute 1985	% Pollen[1] Collectors 1985
Full-time (FT)	125 ± 10 a	78 ± 8 a	39 ± 2 a
Part-time (PT)	134 ± 5 a	121 ± 6 b	36 ± 3 a
No-time (NT)	143 ± 12 a	107 ± 6 b	49 ± 5 b
Control (C)	184 ± 8 b	132 ± 7 b	36 ± 4 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 ≤ 0.05).

Table 2. Mean Honey Production of Colonies Representing 4 Pollen Trapping Treatments, St. Paul and Rosemount, MN, 1984-1985.

Treatment	Weight Gain during Main Flow (kg)[1] 1984	Weight Gain during Main Flow (kg)[1] 1985
FT	44.4 ± 5.4 a	13.2 ± 4.1 a
PT	52.2 ± 3.6 ab	29.5 ± 2.7 b
NT	53.1 ± 4.5 ab	34.9 ± 2.3 c
C	63.0 ± 2.3 b	40.8 ± 2.3 d

[1]Mean ± Standard error (n = 6).
Means for each year followed by different letters are significantly different using Student-Newman-Keuls' mean separation (p ≤ 0.05).

Table 3. Moisture Content of Honey from Colonies Representing 4 Pollen Trapping Treatments, Rosemount, MN, 1985.

Treatment	% Moisture
FT	19.81
PT	19.60
NT	17.82
C	17.60

Table 4. Mean Percent Nitrogen of Adult Bees from Colonies Representing 4 Pollen Trapping Treatments, St. Paul and Rosemount, MN, 1984-1985.

Treatment	Percent Total Kjeldahl Nitrogen[1] Oct. 17, 1984	May 2, 1985	June 26, 1985
FT	7.61 ± 0.28 ab	7.49 ± 0.22 a	6.17 ± 0.10 a
PT	7.56 ± 0.18 ab	7.80 ± 0.19 a	6.19 ± 0.25 a
NT	7.93 ± 0.18 a	7.85 ± 0.11 a	5.92 ± 0.18 a
C	7.03 ± 0.21 b	7.81 ± 0.16 a	6.20 ± 0.12 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 ≤ 0.05).

One alternative may be to remove traps during the nectar flow to allow colonies free flight and more ventilation at this critical time.

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CORRECTION

Due to an error the subtitle of Part I of Pollen Trapping Honey Bee Colonies in Minnesota which appeared in the October issue was incorrect. That subtitle should have read as follows: **Part I: Effect on Amount of Pollen Trapped, Brood Reared, Winter Survival, Queen Longevity, and Adult Bee Population.**

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