



Effect of strengths of honeybee colonies and mesh diameter of traps on the collected pollen grains at three localities of Elsharkia Governorate, Egypt

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Abstract

A comparative study on the weights of collected pollen grains by foraging workers at three strengths of honeybee colonies (strong, medium, and weak), as well as at three mesh diameter of traps (5, 5.5 and 6.0 mm) of three localities located in Elsharkia Governorate for two successive seasons. Statistical analysis of the obtained results of the first season March 2018 – February 2019, cleared that there were no significant differences in the weights of collected pollen grains by honey bee workers among the three localities under study, while there was a significant difference in the weights of collected pollen grains by honey bee workers among the three strengths of honeybee colonies (strong, medium, and weak). The highest weights were recorded at the strong colony 9 frame 4171.6 g/ season, followed by medium colony 7 frame 3608.3 g/season, while the weak colony 5 frame gained only 750 g/ season with significant differences. As for the first season March 2018 – February 2019, statistical analysis of the obtained results cleared that there were no significant differences in the weights of collected pollen grains by honey bee workers among the three localities under study, while there were significant differences in the weights of collected pollen grains by honey bee workers among the mesh diameter of traps (5, 5.5, 6.0 mm). The highest weights were recorded at mesh trap diameter 5 mm (39.9 g) and (35.5 g) at mesh trap diameter 5.5 mm without significant differences, while mesh trap diameter 6 mm gained only (29.7 g) with significant differences. It is worth to note that, the obtained results during the second season of study were confirmed with that of first one.

Keywords: *Apis mellifera*, Apiculture, honeybee, foraging worker, pollen traps.

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1. Introduction

The amount of pollen grains is usually positively correlated with colony size, the exact correlation differing in various sources. The amount of stored pollen grains in a colony is directly proportionate to the number of bees, but the number of brood cells per bee is inversely proportionate to the number of bees. Strong colonies produce more pollen grains in the spring comparing to the other seasons where the differences usually statistically significant. In Sohag Governorate [1], recorded a shortage in pollen storing during April and the maximum area of bee bread was recorded during August. In Giza [2], revealed that gathering and storing pollen began slightly during January recording 2178.5

pollen cells/colony, representing 5.7% increased during February to 6.5% and reached its maximum rate of gathering pollen (12.8%) during August, and declined gradually to its minimum value stored pollen during December. [3] in Kafr El Sheikh region, recorded the highest collected pollen was 95.7&98.3 g/day from colonies located in mixed fields (rice and maize) followed by Maize fields (80.2&73.1 g/day) in 2001 and 2002 seasons. [4] in Mansoura, recorded that the amount of trapped pollen during the whole season with an average of 1697 g/colony/season. [5] reported that the highest rate of stored pollen was during August, and the lowest was during July, the highest seasonal amount of pollen storage was recorded in summer (44.39%), followed by

Autumn, winter and spring recording 25.3, 17.48 and 12.83%. In addition, [6] in Dakahlia Governorate, recorded that spring season was the highest season in collecting pollen, with 316.68 g/colony, representing (38.18%) in contrast, winter was inferior with 88.97 g/colony, representing (10.73%). [7] found that the total mean yield of pollen from the entrance trap and the fixed bottom trap was found to be 12.55 ± 1.66 g and 22.5 ± 1.25 g respectively. [8] used a pollen trap fixed at the entrance to the hive for each colony in the experiment and pollen was collected from colonies of honey bees (*Apis mellifera* L.) during two consecutive seasons, 2009 and 2010, the results showed that in 2009 the pollen weight 2354.89 g / colony/season (average 588.72 g / colony/season), with the average amount of pollen collected high in summer and spring, while it decreased in autumn and winter. In summer, total weight of trapped pollen was 1299.97 g (mean 92.86 g/ colony/week) with a peak in July.

So, the aim of this study is to conduct a comparative study on the strength and trap types of the bee colonies on the collected weights of pollen grains by foraging workers throughout two seasons at three localities (Diarb Negm city, Abo kabeer, Kafar Sakr) of Elsharkia Governorate.

2. Materials and Methods

The field experiments were carried out in private apiaries located at Diarb Negm, Abo kabeer, and Kafr Sakar localities during the period from February 2018 to January 2020 at Elsharkia Governorate, Egypt.

2.1: Honeybee colonies

All private apiaries of the honeybee, *Apis mellifera* L. colonies at El Elsharkia Governorate Were Carniolan hybrids. Fifteen honeybee colonies from each locality were selected which were different in its strength and population for the study on the effect of three strengths of honeybee colonies (strong 9 frame, medium 7 frame, and weak 5 frame) on the weights of collected pollen grains by honeybee colonies. Another fifteen honeybee colonies from each locality were selected which were similar in its strength and population for the study on the effect of mesh diameter of traps (5, 5.5, 6.0 mm) on the weights of collected pollen grains by honeybee colonies. Chosen colonies were arranged in completely randomized block design for each experiment.

2.2: Procedure of work

Chosen colonies were observed and examined during the period from February 2018 to January 2020 where three kinds of pollen grain traps were chosen for this study as follow:

2.2.1: The effect of colony strength on collecting pollen grain

- Colony 1 (9 frames) and the trap was hanging in front of the breeding box of the hive.
- Colony 2 (7 frames) and the trap was hanging in front of the breeding box of the hive.
- Colony 3 (5 frames) and the trap was hanging in front of the breeding box of the hive.

2.2.2: The effect of opening diameter of pollen grain trap mesh on collecting process

- Trap 1 (4.5 mm diameter of trap mesh) was hanging in front of the breeding box of the hive.
- Trap 2 (5 mm diameter of trap mesh) was hanging in front of the breeding box of the hive.
- Trap 3 (5.5 mm diameter of trap mesh) was hanging in front of the breeding box of the hive.

2.2.3: Pollen grain collection and weighting

The trapped pollen grains were calculated every 6 days, where the weight of pollen grains were determined. Observation was lasted 5 times per month. Every treatment was replicated three times.

2.3: Statistical analysis of the data

Collected data were subjected to statistical analysis of variance (ANOVA) at 5 % probability, and the measurements were separated using Duncan's Multiple Range Test (DMRT) through CoStat software program (Version 6.400). CoStat version 6.400 Cohort Software [9]. 798 Lighthouse Ave. PMB 320, Monterey, CA, 93940, USA.

3. Results and Discussion

3.1: Effect of three strengths of honeybee colonies (strong, medium, and weak) on collected pollen grains at three localities of Elsharkia Governorate for two successive seasons

The obtained results in Tables (1 and 2) show the effect of three strengths of honeybee colonies (strong 9 frame, medium 7 frame, weak 5 frame) on collecting pollen grains at three localities of Elsharkia Governorate for two successive seasons.

As for the first season March 2018 – February 2019, statistical analysis of the obtained results (Table 1) cleared that there were no significant differences in the weights of collected pollen grains by honey bee workers among the three localities under study, while there were significant differences in the weights of collected pollen grains by honey bee workers among the three strengths of honeybee colonies (strong, medium, and weak). The highest weights were recorded at the strong colony 9 frame 4171.6 g/ season, followed by medium colony 7 frame 3608.3 g/season, while the weak colony 5 frame gained only 750 g/ season with significant differences.

As for the second season March 2019 – February 2020, statistical analysis of the obtained results (Table 2) cleared that there were no significant differences in the weights of collected pollen grains by honey bee workers among the three localities under study, while there were significant differences in the weights of collected pollen grains by honey bee workers among the three strengths of honeybee colonies (strong, medium, and weak). The highest weights were recorded at the strong colony 9 frame 4116.6 g/ season, followed by medium colony 7 frame 2893.3 g/season, while the weak colony 5 frame gained only 696.6 g/ season with significant differences.

Table 1: Effect of colony strength on pollen grain weights (g) along one season (March 2018 – February 2019) at three localities

Type of Colony	Strong colony 9 frame	Medium colony 7 frame	Weak colony 5 frame	Total	Mean
Weight of pollen grain (g) / season					
Diarb Nigm	4290	3845	900	9035	3011.6
Abo Kabeer	4185	3750	750	8685	2895.0
Kafr Sakr	4040	3230	600	7870	2623.3
Total	12515	10825	2250	25590	8529.9
Mean	4171.6 a	3608.3 b	750 c	8530	2843.3
LSD 5%	475.2				NS

Values followed by different letters for column or row means significant difference at 5%

Table 2: Effect of colony strength on pollen grain weights (g) along one season (March 2019 – February 2020) at three localities

Type of Colony	Strong colony 9 frame	Medium colony 7 frame	Weak colony 5 frame	Total	Mean
Weight of pollen grain (g) / season					
Diarb Nigm	4150	3540	850	8540	2846.6
Abo Kabeer	4050	3012	710	7772	2590.6
Kafr Sakar	4150	2128	530	6808	2269.3
Total	12350	8680	2090	23120	7706.5
Mean	4116.6 a	2893.3 b	696.6 c	7706.6	2568.8
LSD 5%	502.7				NS

Values followed by different letters for column or row means significant difference at 5%

3.2: Effect of mesh diameter of traps (5, 5.5, 6.0 mm) on the weights of collected pollen grains by honeybee colonies at three localities of Elsharkia Governorate for two successive seasons

The obtained results in Tables (3, 4) show the effect of mesh diameter of traps (5, 5.5, 6.0 mm) on the weights of collected pollen grains by honeybee colonies at three localities of Elsharkia Governorate for two successive seasons. As for the first season March 2018 – February 2019, statistical analysis of the obtained results (Table 3) cleared that there were no significant differences in the weights of collected pollen grains by honey bee workers among the three localities under study, while there were significant differences in the weights of collected pollen grains by honey bee workers among the mesh diameter of traps (5, 5.5, 6.0 mm). The highest weights were recorded at mesh trap diameter 5 mm (39.9 g) and (35.5 g) at mesh trap diameter 5.5 mm without significant differences, while mesh trap diameter 6 mm gained only (29.7 g) with significant differences. Regarding to the results of the second season March 2019 – February 2020, statistical analysis of the obtained results (Table 4) recorded that there were no significant differences in the weights of collected pollen grains by honey bee workers among the three localities under study, while there were significant differences in the weights

of collected pollen grains by honey bee workers among the mesh diameter of traps (5, 5.5, 6.0 mm). The highest weights were recorded at Mesh trap diameter 5 mm (41.5 g) followed by (36.5 g) Mesh trap diameter 5.5 mm with significant differences, while Mesh trap diameter 6 mm gained only (32.0 g) with significant differences.

The obtained results of this research are in harmony with those conducted by [10] at Kafr El-Sheikh, [11] at Kafr El sheikh region and [12] at Assiut governorate. Furthermore, [13] in Dokki, Egypt, who found that the weight of trapped pollen per colony was 781.80 g collected from 22 plant sources in trees represented the most important source for pollen supplying more than 80%. [8] conducted this study in an apiary located in the Faculty of Agriculture, Fayoum University using a group of equal strength honey bee colonies and First *Apis Carniolan* hybrid Carnica queens, and the front pollen trap was used throughout the study period (2009 and 2010), fresh pollen granules for each trap were daily collected, and found that summer and spring were the best seasons for the huge pollen range, while fall and winter were the lowest in the area tested. [14] indicated that the highest number of brood cells, the highest number of stored pollen cells and the heaviest pollen pellets gathered in the traps were recorded in hives of F1 Carniolan colonies supplied with pollen grain cake followed by yeast cake and soya bean cake.

Table 3: Effect of trap diameter mesh (mm) on pollen grain weights (g) along one season (March 2018 – February 2019) at three localities

Locality	Mesh trap diameter 5 mm	Mesh trap diameter 5.5 mm	Mesh trap diameter 6 mm	Total	Mean
pollen grain weights (g) / trap / 12 days					
Diarb Nigm	41.40	37.20	32.00	110.6	36.8
Abo Kabeer	38.30	35.40	29.00	102.7	34.2
Kafr Sakar	40.10	36.10	28.10	104.3	34.7
Total	119.8	108.7	89.1	317.6	105.7
Mean	39.9 a	36.2 a	29.7 b	105.8	35.2
LSD 5%	3.8				NS

Values followed by different letters for column or row means significant difference at 5%

Table 4: Effect of trap diameter mesh (mm) on pollen grain weights (g) along one season (March 2019/ February 2020) at 3localities

Locality	Mesh trap diameter 5 mm	Mesh trap diameter 5.5 mm	Mesh trap diameter 6 mm	Total	Mean
pollen grain weights (g) / trap / 12 days					
Diarb Nigm	43.20	38.40	33.20	114.8	38.2
Abo Kabeer	39.20	37.20	30.20	106.6	35.5
Kafr Sakar	42.30	34.00	32.60	108.9	36.3
Total	124.7	109.6	96.00	330.3	110.0
Mean	41.5 a	36.5 b	32.00 c	110.1	36.6
LSD 5%	4.1				NS

Values followed by different letters for column or row means significant difference at 5%

[15] conducted an experiment in March 2011, Islamabad in sixteen colonies of honey bees of equal strength; four types of pollen traps were compared, and found that the total pollen yield of Gujranwala trap, HBRI, fixed bottom plate and China cut trap was found to be 83.00 + or 3.92 (medium + or SE), 121.50 + or 2.87 (medium + or - SE), 79.50 + or 2.33 (Mean + or - SE), 66.00 + or 1.78 (median + or - SE) respectively. [16] studied in a field experiment the power of the honeybee colonies for collecting the pollen during the different seasons in Egypt, whereas the experimental results revealed that the honeybee colonies collected more amount of pollen during summer season, while the low amounts of collected pollen were during winter season. There were significant differences between all months and between all four seasons. The mean amount of pollen trapped during Citrus season was 247.66 g pollen / colony, while the mean amounts of pollen trapped were 355.00 and 1043.33 g pollen / colony during the Clover and Corn seasons respectively. [17] found that the loss of pollen mobilizes the bees, where it increases both the number of field bees and the number of flights and added that the amount of collected pollen from one colony during one day ranged from 50 to 250 g, as well as one bee colony gives 1 to 7 kg of pollen a season. [18] compared the Italian bee strain and the Carniolan bee strains during two consecutive seasons of the study and found that the superiority of the Italian bee breeds in pollen collection during the first season of the study with a *Elbaz et al., 2023*

total of (1447 g/colony/season) greater than that of Carniolan (1415 g/colony/season). [19] used eight equal-strength honey bee colonies, headed by new queens, the queens of a local breed mate in collecting pollen by used the entrance traps during the months of the season. The results showed that the largest amount of trapped pollen was in August (106.19 g/colony) followed by September (79.22 g/colony) while May recorded the lowest (29.51 g/colony). [20] conducted this experiment using 16 new honey bee colonies of equal size containing five sections of brood frames May 2015 in new Lang troth hives of 10 frames, front pollen traps were installed in each hive for 72 hours and recorded the weights of pollen grains. [21] used traps to collect bee pollen from honey bee colonies by placing at the entrance of the beehive, and concluded that, the honey bee colony has 10,000 to 15,000 adult honey bee workers need about 13.40 to 17.80 kg per season.

4. Conclusions

The highest weights were recorded at mesh trap diameter 5 mm (39.9 g) and (35.5 g) at mesh trap diameter 5.5 mm without significant differences, while mesh trap diameter 6 mm gained only (29.7 g) with significant differences. It is worth to note that, the obtained results during the second season of study were confirmed with that of first one.

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