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THE RELATIONSHIP BETWEEN FORAGING ACTIVITY OF HONEY BEE (*APIS MELLIFERA* L.) AND BEE POLLEN STORAGE

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ABSTRACT

Foraging behavior is one of the amazing behaviors of honey bees, *Apis mellifera*. Foraging behavior is not useful only for feeding the colony by collecting the nectar and pollens but for plant pollination and other benefits. Bee pollen is good food product with nutritional profile and therapeutic benefits. This study aimed to evaluate the relation between foraging activity and storing pollens. Ten honey bee colonies located in Faculty of agriculture apiary at Minia region at seasons 2018/2019 and 2019/2020. Data showed positive relation between foraging bees activity and stored pollen area also, the highest foraging bees activity and stored pollen area was recorded in summer and spring season and the lowest in autumn and winter. Data showed that the highest mean foraging bees (53.64 and 37.56 bees) in August and July (summer season). On the other hand, results showed that the highest of mean pollen area (128.4 and 131 inch^2) in June month in summer season. While, the lowest of mean pollen area (1.2 and 1.4 inch^2) in winter season**.**

Keywords: Honey bee, foraging, pollen

INTRODUCTION

Bees play an important role in pollinating plants which pollinates 75-80% of plants (**Johannsmeier and Mostert, 2001)**. Honey bee pollinators (foragers) are contributes toproducing 30 % of the human food directly or indirectly (**Greenleaf and Kremen, 2006**). Foraging bees can be classified into two jobs scout bees and the reticent bees which wait the scout bees come back and give them information about

the nectar and pollen source by dancing (**Nest and Moore, 2012**). Forager bees can the collection of water, nectar, pollen different sources (**Abou-Shaara, 2012**). Honey bee produced available products such as honey, royal jelly, propolis, bee venom, bee pollen and beeswax, all this natural products have been attracted the interest of both consumersand industries because their nutritional properties and therapeutic potential (**Cornara *et al.*, 2017).**Bee pollen is consider another product of the beehive, which consumed by the population, because of its chemical composition (**Komosinska-Vassev *et al.*, 2015; Campos *et al.*, 2016**). Pollen grains are considered the male germs from the flower, its rich in high useful protein, which serve as the building compounds for growth and tissue repair to honey bee colonies **(Al-Ghamdi, 2002 and Mishima *et al.*, 2005)**. Bee pollen is considered of the main source of the foodto the honeybees.This product is produced from interaction between flower pollenand nectar and carried out by the worker bees (**Campos *et al.*, 2008**). Workers convert pollen to important productionof brood food and develop the hypopharyngeal gland and fat body (**Keller, 2005**). This study aimed to evaluate the relation between foraging activity and storing pollens.

2. MATERIALS AND METHODS

2.1. Ten Carnioilan honey bees (*Apis mellifera carnica*) colonies having equal strength (bees covered 7 wax combs), equal stored honey and pollen and located in Faculty of agriculture apiary at Minia region, Egypt. Trails of the study were conducted through two successive years 2018/2019 and 2019/2020.

2.2. Pollen area (stored pollen):

Colonies inspected at 12 day intervals over the season. Pollen area was measured by using wired grad frame divided to 1.0 $inch^2$ (**De Jong, 1976**).

2.3. Monitoring of foraging activity: Foraging activity was measured by the number of bees returning and leaving to the hive in a min.(**Abou-Shaara *et al.* 2013**)

2.4. Statistical analysis Also, correlation and regression coefficients were estimated according to method of **Mead *et al.*, 1993**.

3. RESULTS AND DISCUSSION

3.1. Summer season

Data in Table (1) and Figure (1) showed that the highest of mean pollen area (128.4 and 131 $inch^2$) were recorded at28^{th}, 23^{rd} June in summer seasons 2018/2019 and 2019/2020 respectively. While, the lowest of mean pollen area (9.6 and 8.2 $inch^2$) were recorded at 8^{th} and 10^{th} September in summer seasons 2018/2019 and 2019/2020 respectively. On the other hand, the highest mean foraging bees (53.64 and 37.56 bees) were recorded at 15^{th} August and 17^{th} July in summer seasons 2018/2019 and 2019/2020 respectively. But the lowest mean foraging bees (21.96 and 24.44 bees) were recorded at 20^{th} September and 10^{th} August July in summer seasons 2018/2019 and 2019/2020 respectively. Also, mean the biggest number of foraging bees was 36.43 and 39.11 bees

at 12:00 pm in seasons 2018/2019 and 2019/2020 respectively and reverse it at 10:00 am was 26.33 bees in 2018/2019 and at 08:00 am 23.41bees in2019/2020. Regression coefficient between mean pollen area and mean foraging bees were 0.6412 and 0.04091, which means that increasing of foraging bees by one bee, revealed to increasing pollen area by0.6412 and 0.04091inch^2 in seasons 2018/2019 and 2019/2020 respectively. These results came agree with **Ismail *et al.* (2013**) who found that the mean collected amount of pollen in summer season was 588.72 g/colony/season. Also, **Alqarni, (2006) and Couvillon *et al.*, 2014** they floral resources increase in Summer months of July and August.

3.2. Autumn season

Results in Table (2) and Figure (2) that of autumn season clarified that mean the lowest number of foraging bees was recorded(9.34 and 9.63 bees) at 04:00 pm while, the highest number of foraging bees was recorded (15.97 and 17.23 bees) at 10:00 am in seasons 2018/2019 and 2019/2020 respectively. In addition to, data in autumn showed positive relationship between foraging activity and storing pollens in colony and confirmed this statistical analysis, which, regression coefficient between it's, was 0.3451 and 0.2437.

Also, data in two autumn seasons 2018/2019 and 2019/2020 increase mean foraging bees and mean stored pollen area in October month compared with the months of November and December. This results were in the same opinion with **Wood *et al.*, (2018**) who found that autumn had the least honeybee abundance of stored pollen. Also, **Okada *et al.*, (2012).** found that in Autumn, a reduction in the amounts pollen coming into the hive causes reduced brood rearing and population.

3.3. Winter season

Results in table (3) and figure (3) claired that, with the beginning of winter decrease numbers of foraging bees (3.86 and 2.6 bees) followed by decrease the pollen stored area (9.2 and 11.4 inch^2 2018/2019 and 2019/2020 respectively). On the other hand, numbers of foraging bees at the end of season 3.86 and 2.6 bees) followed by decrease the pollen stored area (9.2 and 11.4 inch^2 2018/2019 and 2019/2020 respectively). In addition to the highest mean foraging bees (20.52 and 16.72 bees) were recorded at 20th March and 11th March in winter seasons 2018/2019 and 2019/2020 respectively. But the lowest mean foraging bees (0.48 and one bee) were recorded at 12th February and 1st February July in winter seasons 2018/2019 and 2019/2020 respectively.

Data are came agreement with **Reem *et al.* (2021)** they found that reduce of foraging bees and collected pollen. Also, **Meikle and Holst, 2015** they found that winter store levels from honey and pollen and bees need feeding**, (Meikle and Holst, 2015).**

3.4. Spring season

Data in table (4) and figure (4) showed that the regression coefficient between mean pollen area and mean foraging bees were 0.1546 and 0.2978, which means that increasing of foraging bees by one bee, revealed to increasingpollen area by 0.1546 and 0.2978 inch^2 in seasons 2018/2019 and 2019/2020 respectively.

Also, data pointed that the highest of mean stored pollen area (58.6 and 36 inch^2) were recorded at 12th June and 21st May in Spring seasons 2018/2019 and 2019/2020 respectively.

Finally, we can conclude that , its direct relation between foraging bees activity and stored pollen area also, the highest foraging bees activity and stored pollen area was recorded in summer and Spring season. These results are agree with **Fathy (2008)** who found spring as the best season for collecting pollen with an average of 316.68 g/colony representing 38.18%.

Table (1): Relation between foraging activity (n. bees returning and leaving the beehive/min) and stored pollen area during summer seasons 2018/2019 and 2019/2020 at Minia region.

Date		Mean pollen area	Foraging Activity (Mean n. of bees returning and leaving the beehive/min)					
			08:00 Am	10:00 Am	12:00 Pm	02:00 Pm	04:00 Pm	Mean
summer 2018/2019	28 Jun.	128.4	30.2	28	45.4	32.2	30.8	33.32
	10 Jul.	88.8	25.8	30.4	40	33	30.4	31.92
	22 Jul.	48.8	20	30.2	40.8	38.4	28.8	31.64
	3 Aug.	20.8	21.2	15	30	35	20	24.24
	15 Aug.	20	55.8	33	62.2	67	50.2	53.64
	27 Aug.	20.4	18	23.8	28	30.4	20	24.04
	8 Sept.	9.6	20.4	20	30	32.8	30	26.64
	20 Sept.	13.8	30.2	30.2	15	18	16.4	21.96
Mean			27.7	26.33	36.43	35.85	28.33	
Reg. Foraging bees/ pollen area			0.6412					
summer 2019/2020	23 Jun.	131.8	2z8.4	23.8	40	35	30	31.44
	5 Jul.	94.4	25	40	36	35.8	30	33.36
	17 Jul.	44.8	28	38	50.8	38	33	37.56
	29 Jul.	49	22.8	30.2	44	37	32	33.2
	10 Aug.	45	20	16	32	33.2	21	24.44
	22 Aug.	32	23.2	32	43	31.2	33	32.48
	10 Sept.	8.2	17.4	20	28	30	29.8	25.04
Mean			23.54	28.57	39.11	34.31	29.83	
Reg. Foraging bees/ pollen area			0.04091					

*Reg. = Regression coefficient

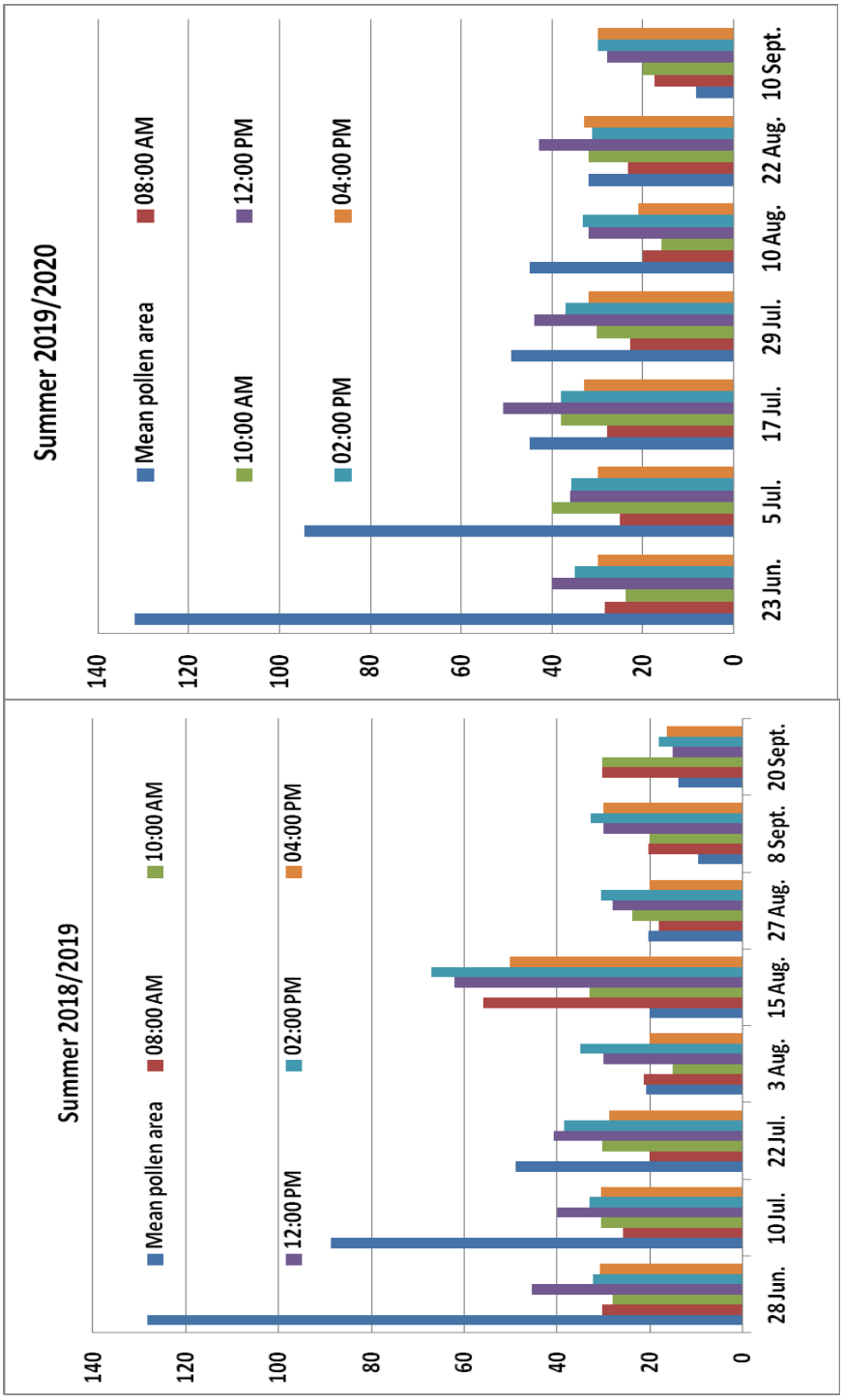

Figure (1): Relation between foraging activity (n. bees returning and leaving the beehive/min) and stored pollen area during summer seasons 2018/2019 and 2019/2020 at Minia region.

Table (2): Relation between foraging activity (n. bees returning and leaving the beehive/min) and stored pollen area during autumn seasons 2018/2019 and 2019/2020 at Minia region.

Date		Mean pollen area	Foraging Activity (Mean n. of bees returning and leaving the beehive/min)					
			08:00 Am	10:00 Am	12:00 Pm	02:00 Pm	04:00 Pm	Mean
Autumn 2018/2019	2 Oct.	23.2	30.8	30	15	15.4	13	20.84
	14 Oct.	19.8	10	30.2	15	18	9	16.44
	26 Oct.	16.8	10.2	20.8	25	20	10	17.2
	07 Nov.	16.4	8.4	5	5	8.4	6	6.56
	19 Nov.	20	20.4	10	5.2	9	6.4	10.2
	01 Dec.	21.8	6	12.8	10	9.8	11	9.92
	13 Dec.	23.4	10.8	3	15	9	10	9.56
Mean			13.8	15.97	12.89	12.8	9.34	
Reg. Foraging bees/ pollen area			0.345					
Autumn 2019/2020	22 Sept.	10.2	27.4	30.4	20	16	17	22.16
	5 Oct.	21.2	28.2	30	14	13	14	19.84
	17 Oct.	18	9.4	30	12.4	16	11	15.76
	29 Oct.	10.8	11	20	28	17.8	11	17.56
	10 Nov.	10	7.2	5	7	8	7	6.84
	22 Nov.	7.2	22.2	10	4.4	9	6	10.32
	4 Dec.	11.4	7	12.4	9	9.2	11	9.72
	16 Dec.	24.8	0	0	0	0	0	0
Mean			14.05	17.23	11.85	11.13	9.63	
Reg. Foraging bees/ pollen area			0.2437					

*Reg. = Regression coefficient

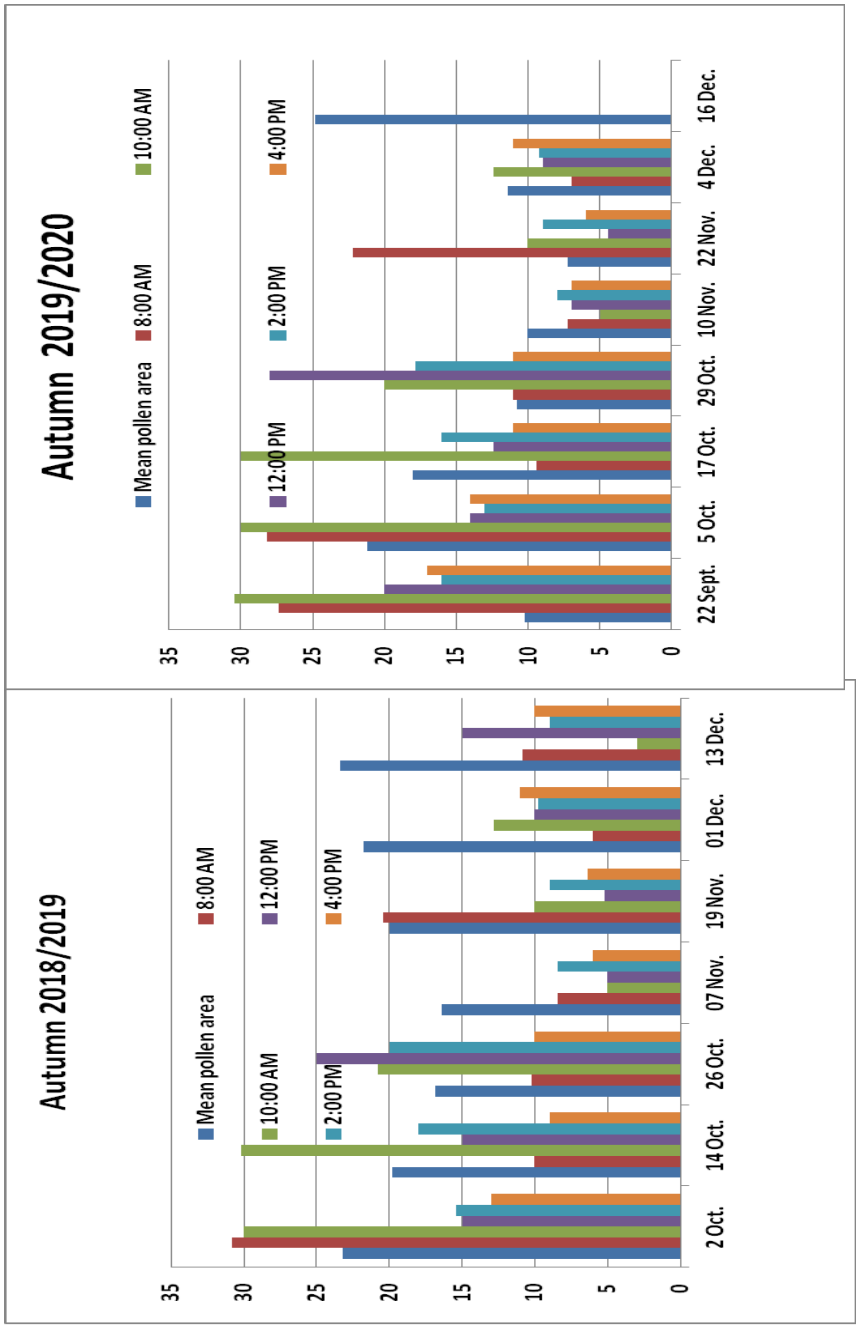

Figure (2): Relation between foraging activity (n. bees returning and leaving the beehive/min) and stored pollen area during autumn seasons 2018/2019 and 2019/2020 at Minia region

Table (3): Relation between foraging activity (n. bees returning and leaving the beehive/min) and stored pollen area during winter seasons 2018/2019 and 2019/2020 at Minia region.

Date		Mean pollen area	Foraging Activity (Mean n. of bees returning and leaving the beehive/min)					
			08:00 Am	10:00 Am	12:00 Pm	02:00 Pm	04:00 Pm	Mean
Winter 2018/2019	25 Dec.	9.2	2.2	5	4.4	3.7	4	3.86
	6 Jan.	10.2	3.8	2	3	2	4	2.96
	18 Jan.	2.4	5.8	3	2.8	4	3	3.72
	30 Jan.	2.66	4	2	2.8	1	0	1.96
	12 Feb.	2.2	0	1.2	0	0	1.2	0.48
	24 Feb.	1.2	0	1.2	1	2	1	1.04
	8 Mar.	1.8	10.2	27	24	15.8	20	19.4
	20 Mar.	29.6	16.8	19.8	23	22	21	20.52
Mean			5.35	7.65	7.63	6.31	6.77	
Reg. Foraging bees/ pollen area			0.4996					
Winter 2019/2020	28 Dec.	11.4	5.2	3	2.8	0	2	2.6
	10 Jan.	11	2.2	2.8	2	3	5	3
	22 Jan.	2.2	3	2.8	3	4.2	2	3
	3 Feb.	2.2	0	2	1	2	0	1
	15 Feb.	2.4	0	22	2.2	1	0	5.04
	27 Feb.	1.4	2.8	3	2	0	0	1.56
	11 Mar.	25.8	11.8	15.8	20	15.8	20.2	16.72
Mean			3.57	7.34	4.71	3.71	4.17	
Reg. Foraging bees/ pollen area			0.5556					

*Reg. = Regression coefficient

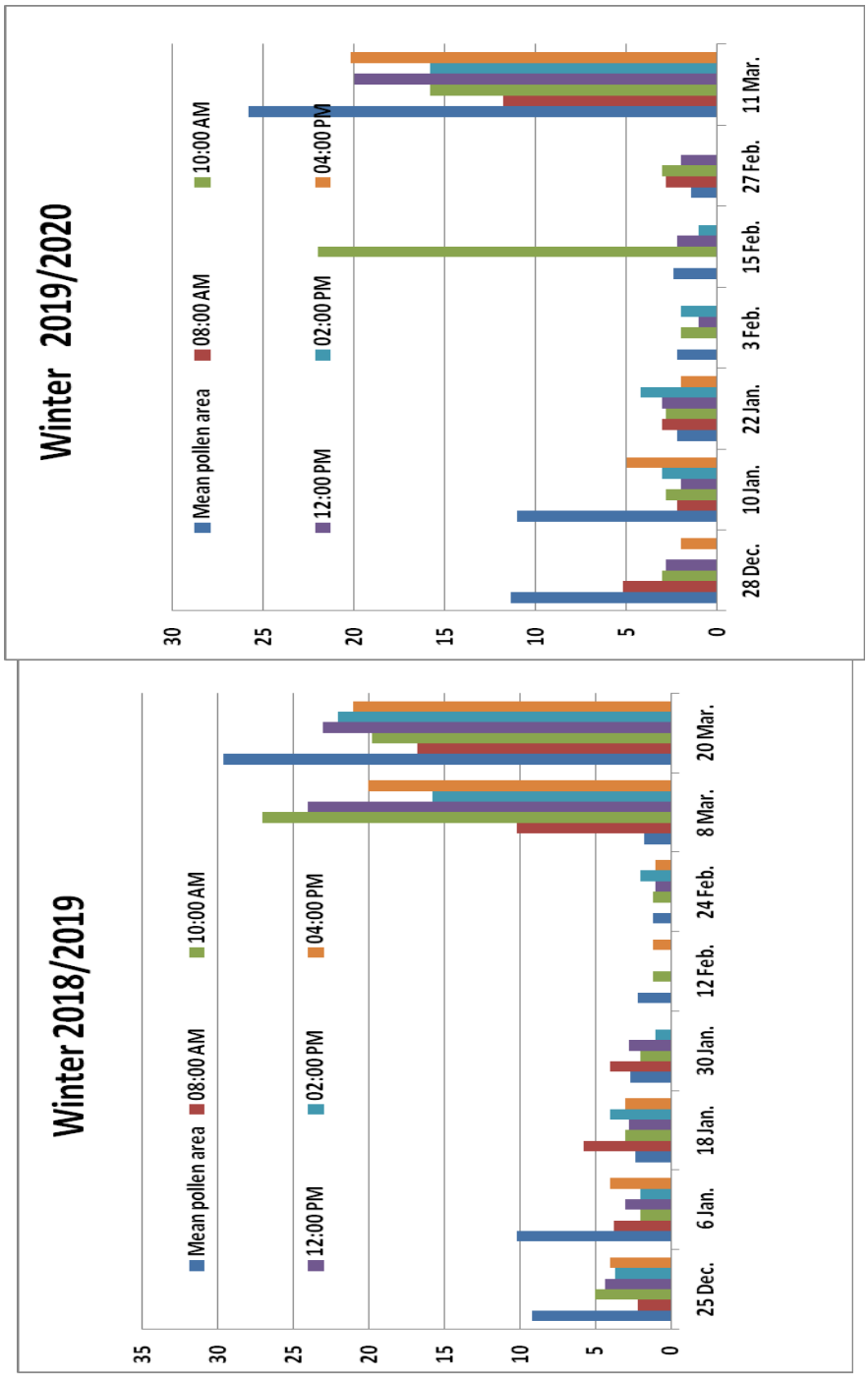

Figure (3): Relation between foraging activity (n. bees returning and leaving the beehive/min) and stored pollen area during winter seasons 2018/2019 and 2019/2020 at Minia region.

Table (4): Relation between foraging activity (n. bees returning and leaving the beehive/min) and stored pollen area during spring 2019 and 2020 at Minia region.

Date		Mean pollen area	Foraging Activity (Mean n. of bees returning and leaving the beehive/min)					
			08:00 Am	10:00 Am	12:00 Pm	02:00 Pm	04:00 Pm	Mean
spring 2018/2019	1 April	39.2	20.2	35	42	35	38	34.04
	13 April	48.4	17.8	22.2	33	35.4	34.4	28.56
	25 April	45.6	19	27	37	36	35	30.8
	7 May	45.6	22.2	33.2	40	38.2	35.2	33.76
	19 May	51.6	22.8	32	44.4	40.4	38	35.52
	31May	55.8	26	31.2	43	40	39.4	35.92
	12 Jun.	58.6	27.8	33	45	42.8	38.8	37.48
Mean			22.26	30.51	40.63	38.26	36.97	
Reg. Foraging bees/ pollen area			0.1546					
spring 2019/2020	21 Mar.	22.8	10.2	20	23	20.4	20	18.72
	3 April	22.2	13	29.2	33.2	25.4	30	26.16
	15 April	23.6	17.4	30	33	35.4	30	29.16
	27 April	26.4	20.8	25.4	40	30	29	29.04
	9 May	27.8	20.8	28	39.4	38.8	37	32.8
	21 May	36	22	27	40	35	33	31.4
	2 Jun.	12.6	15.2	23.2	30	30.2	30.8	25.88
	14 Jun.	17.4	25	20.2	35	30.4	28	27.72
Mean			18.05	25.38	34.2	30.7	29.73	
Reg. Foraging bees/ pollen area			0.2978					

*Reg. = Regression coefficient

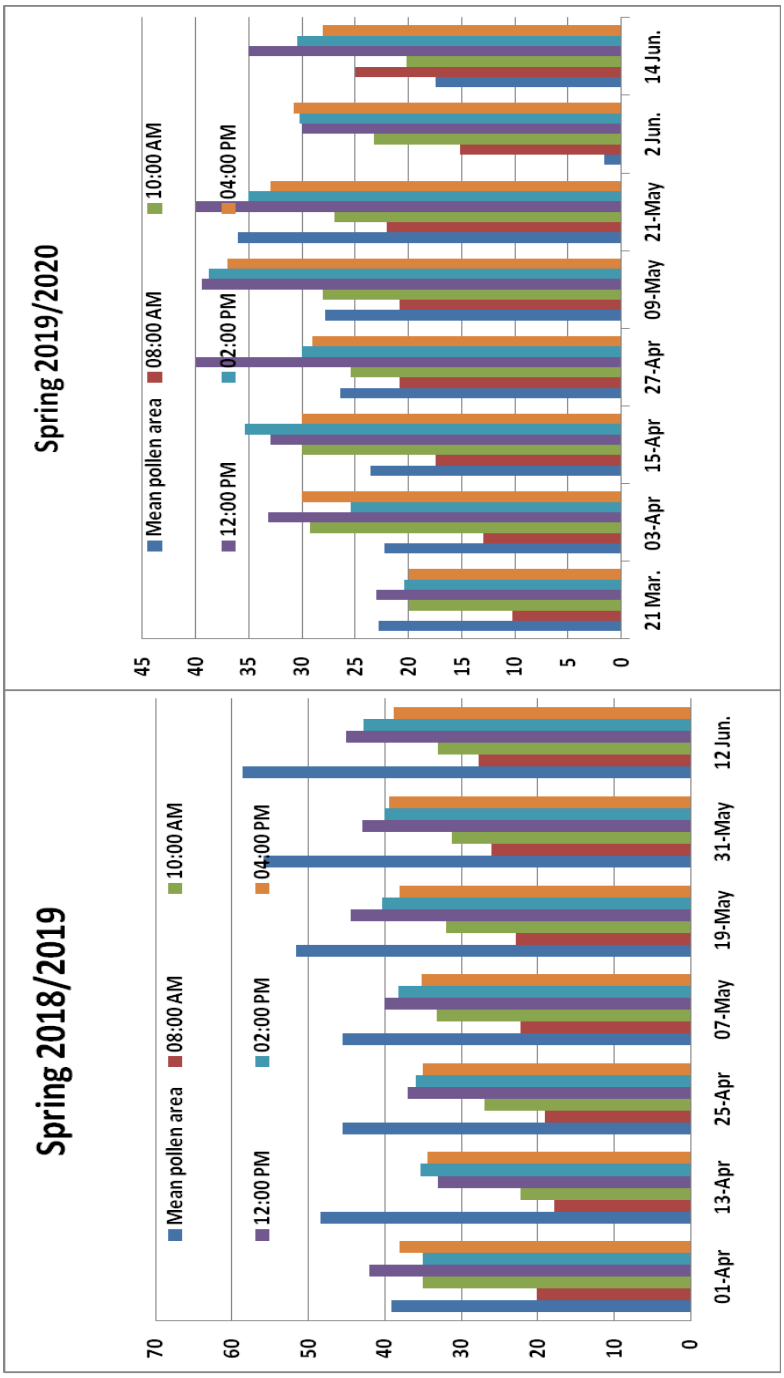

Figure (4): Relation between foraging activity (n. bees returning and leaving the beehive/min) and stored pollen area during spring 2019 and 2020 at Minia region

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الملخص العربي

العلاقة بين نشاط السروح لنحل العسل وتخزين حبوب اللقاح

حصافي محمد عشبة -عبد السلام انور محمد -محمود جمعة درويش
رباب محمد اسماعيل -مشيرة محمد شعبان
قسم وقاية النبات - كلية الزراعة - جامعة المنيا

يعد سلوك السروح من أحد السلوكيات المذهلة لنحل العسل. إن سلوك السروح ام ليس مفيدًا فقط لتغذية الطائفة عن طريق جمع الرحيق وحبوب اللقاح ولكن لتلقيح النباتات وفوائد أخرى. حبوب لقاح النحل منتج غذائي جيد ذو خصائص غذائية وفوائد علاجية. هدفت هذه الدراسة إلى تقييم العلاقة بين نشاط السروح وتخزين حبوب اللقاح. عشر طوائف لنحل العسل موجودة بمنحل كلية الزراعة بمحافظة المنيا خلال الموسمين 2019/2018 و2020/2019. أظهرت البيانات وجود علاقة إيجابية بين نشاط السروح ومساحة حبوب اللقاح المخزنة، كما تم تسجيل أعلى نشاط للسروح ومساحة حبوب اللقاح المخزنة في فصلي الصيف والربيع واقلهم في الخريف والشتاء. أظهرت البيانات أن أعلى متوسط للنحل السارح (53.64 و37.56 نحلة) في شهري أغسطس ويوليو (موسم الصيف). من ناحية أخرى أظهرت النتائج أن أعلى متوسط لمساحة حبوب اللقاح (128.4 و131 بوصة مربعة) في شهر اغسطس في فصل الصيف. بينما كان أقل متوسط لمساحة حبوب اللقاح (1.2 و 1.4 بوصة2) في فصل الشتاء.