



ROLE OF POLLINATORS ON EGYPTIAN CLOVER POLLINATION WITH SPECIAL REFERENCE TO HONEYBEE AT SOHAG GOVERNORATE, EGYPT

[77]

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ABSTRACT

Data revealed that Egyptian clover were visited by 22 genus of arthropods belong to 16 families and 7 orders. The identified species were classified to phytophagous, Nectarivore, predatory insects. During both seasons *Apis mellifera* L. and *Megachile* sp. were the most abundant pollinators detected at the first week of May till the end of flowering season in mid-June. The highest activity period for *A. mellifera* was detected at 11:00 am. However, the lowest activity was found at 3:00 pm. and 5:00 pm. in both seasons, respectively, with insignificant difference between them in the first season. Whereas the highest activity period for *Megachile* sp. was detected at 1:00 pm. and the lowest activity was found at 7:00 am. During both seasons. The free pollination treatment produced the highest mean number of seeds per head followed by the caged with honeybees followed by the caged without honeybees treatment with average (48.15, 43.85 and 13.20 seeds /head) and (51.10, 46.10 and 10.85 seeds /head) during 2017 and 2018 seasons, respectively. The caged plants without honeybees produced the low weight of 1000 seed. Whereas the non-caged treatment produced the highest weights with an average (2.75 and 2.55 g) and (3.50 and 3.90 g) during both seasons, respectively.

Keywords: Egyptian clover, Seed yield, Pollinators, Bees.

INTRODUCTION

Egyptian clover (Berseem) *Trifolium alexandrinum* L. is a winter annual legume of major importance to Egyptian agriculture as a principle

source of forage and for conserving soil fertility under intensive cropping (Bakheit, 2013). It's considered a source of protein, phosphorus, calcium, and other minerals for animals and a source of nectar and pollen for bees so that it has played a key role in the development of meat, milk, poultry, beekeeping and related industries (Jat et al 2014a). In Egypt, clover is a major seed export crop, annual export of clover seed have to more than 12000 tons in 2001 and the main honey producing crop (El-Nahrawy, 2005).

Nearly 75% of the world's flowering plants are dependent on insects for pollination (Bezabih and Gebretsadikan, 2014). The western honey bee, *Apis mellifera* L., is the premier managed pollinator in the United States; the value of its contribution to agriculture in the form of providing pollination services to over 90 crop species exceeds \$14 billion annually (Morse and Calderone, 2000).

Forage crops are absolutely dependent on insect pollination (Klein et al 2007). Egyptian clover reported to be highly self-incompatible (Jat et al 2014a). In most cases, honeybees' colonies are brought into clover crops during the flowering season (Goodwin et al 2011).

So, the objective of this study was to survey Egyptian clover insect visitors specially pollinators and study the population dynamic of the bees during the flowering season and their diurnal activity. Also, make a comparison between seed yield of caged with honeybees, caged without honeybees and non-caged plants, also compared the 1000 seed weight between it.

MATERIALS AND METHODS

The present study was carried out in the Experimental Farm of Shandaweel Agricultural Research

Station at Sohag Governorate, during two successive growing seasons of 2017 and 2018. An area of about one Feddan was assigned for different experiments conducted in the current study. By October at the two seasons, the Egyptian clover (Giza 6) seeds were planted with three replicates in complete randomized block design. Experimental plots received regular cultural practices as recommended, except the use of any pesticides.

1) Survey of clover insects

Direct observations and sweep net collection methods were used to survey certain insects that visited and occurred on plants. Unknown collected adults were identified in the Plant Protection Research Institute, Agriculture Research Centre in Giza, Egypt.

2) Diurnal and seasonal activity of pollinators

Mean number of pollinators /m²/minute visits Egyptian clover florets were calculated by direct observation throughout the blooming periods. Counts were taken twice a week at two hour intervals throughout the day, starting from 7.00 am to 5.00 pm. Three replicates were estimated by the aid of one square meter using a wooden frame during the blossom period of Egyptian clover according to **McGregor et al 1965**.

3) Effect of honeybees on the Egyptian clover seed yield

The effect of honeybee as pollinator of Egyptian clover was investigated by three treatments. The first was caged with a nucleus hive of honeybees contains about 100 bees with small frame of honey and change it's weekly at night, the second, caged without honeybees and the third was the control without cages.

a) Number of seeds per head

Average numbers of seeds obtained from 20 heads were counted with the help of seed counter.

b) 1000-seed weight

Thousand seeds from each replication of individual treatments thus counted were weighed with the help of an electronic balance to get 1000-seeds weight in grams.

For statistical analysis data were analyzed by analysis of variance. When the resulted F-tests

were significant, L.S.D test at 0.05 was used to partition the means into significant ranges.

RESULTS AND DISCUSSIONS

1) Survey of clover insects

As shown in **Table, 1** data were, in descending order to give a general picture for the arthropod specimens that have been identified. However, arthropods listed represent 22 genus of Arthropods belong to 16 families and 7 orders. The identified insect species that listed in this table were classified to Phytophagous, Predator and Nectarivore.

Of all genus, 19 species were identified and the other 3 which were not identified belonging to *Syrphus* genus, *Megachile* genus and *Orius* genus. Order Hymenoptera was most abundant, Lepidoptera, Diptera, Coleoptera, Hemiptera, Neuroptera and Odonata which recorded 29.2,16.7, 16.7,16.7, 12.5, 4.2 and 4.2%, respectively (**Fig. 1**).

These data were in agreement with those of **Mabrouk and Mahbob (2017)**, who recorded in the Egyptian clover field twenty two insect species, including five species of pests, five species of natural enemies and twelve of pollinators (*Phyllanthus abdelkader*, *Polistes gallica*, *Vespa orientalis*, *Eumenus maxillosa*, *Megachile uniformis*, *Megachile submucida*, *Megachile muntusemina*, *Osmia* spp., *Chalcidoma siculum*, *Apis mellifera* L. *Andrena* spp. and *Ocnera hispida*).

Wagan et al (2015) who stated that insect pests on berseem crop, were: aphid, leaf miner, dusky bug, thrips, whitefly, cricket, and cutworm, respectively. Whereas the natural enemies were; rove beetles, lady bird beetle, ant, spider, big eyed, and green lacewing. **Hameed et al (2016)** revealed that armyworm, *Spodoptera exigua*, aphid (*Sitobian avenae* L.) and leaf miner (*Aproaerema modicella*) are important pests of berseem while the *Coccinellids* and a *Syrphid* fly are important predators and honeybee are important pollinators of berseem.

Hesain (2013) recorded eleven species of bees and other insects on the flower of the clover, which are four species from hymenoptera, (*Apis mellifera*, *Megachil* sp., *Halictus* sp. and *Anderena* sp.), three species of diptera were (*Metasyrphus taeniops*, *Eristalis anaeus* and *Episyphus balteatus*) and four species of Lepidoptera it were (*Lycaeides Melissa* (alpime), *Autograph gamma* L., *Colias croceus* L., and *Artogeia rapa*).

Omran (1992) reported that in Qena region (Upper Egypt) *Apis mellifera*, *Megachile submucidae* and *Andren fuscosa* the most abundant hymenopterous visiting the Egyptian clover flowers.

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Table 1. A partial taxonomic list of insects collected from Egyptian clover by using sweep net and direct count methods during 2017 and 2018 flowering seasons.

Order	Family	Common name	Scientific name	Status
Odonata	Aeshnidae	Dragon fly	<i>Hemianax ephippiger</i> Burmister	Pre.
	Anthocoridae	Flower Orius bugs	<i>Orius</i> sp.	Pre.
Hemiptera	Pentatomidae	Green stink bug	<i>Nezara viridula</i> L.	Phyto.
	Cicadellidae	Potato leaf hopper	<i>Empoasca decipiens</i> Paoli.	Phyto.
Neuroptera	Chrysopidae	Green lacewing	<i>Chrysoperla carnea</i> (Steph.)	Nect.Pre.
Lepidoptera	Pieridae	Small cabbage white	<i>Pieris rapae</i> L.	Nect., & Phyto.
	Lycanidae	Pea blue butterfly	<i>Lampides boeticus</i> L.	Nect., & Phyto.
	Noctuidae	Cotton leafworm	<i>Spodoptera littoralis</i> Boisduval	Nect., & Phyto.
		Beet armyworm	<i>Spodoptera exigua</i> Hubner	Nect., & Phyto.
Coleoptera	Coccinellidae	Eleven-spot ladybird	<i>Coccinella undecimpunctata</i> L.	Pre.
		Convergent lady beetle	<i>Hippodamia convergens</i> Guerin-Me.	Pre.
		Variiegated ladybug	<i>Hippodamia variegata</i> Goeze	Pre.
	Curculionidae	Egyptian alfalfa weevil	<i>Hypera brunneipennis</i> Boh.	Pre.
Hymenoptera	Apidae	Honeybee	<i>Apis mellifera</i> L.	Nect.
	Megachilidae	Carpenter bee	<i>Xylocopa pubescens</i> Spinola	Nect.
		Alfalfa leafcutter bee	<i>Megachile</i> sp.	Nect.
	Sphecidae	Bee-wolf	<i>Philanthus triangulum</i> F.	Nect.& Pre.
		Oriental hornet	<i>Vespa orientalis</i> L.	Nect. & Pre..
	Vespidae	Paper wasp	<i>Polistes gallicus</i> L.	Nect.
		Yellow jacket	<i>Vespula squamosa</i> D.	Nect.
Diptera	Muscidae	Orientalis house fly	<i>Musca domestica</i> (Macq.)	Nect.
	Syrphidae	Hover fly	<i>Syrphus</i> spp.	Nect. & Pre.

Nect: Nectarivore, an insects feed on a nectar produced by flowering plants.

Pre: Predator, an insect that feed on other insects or on one of their stages

Phyto: Phytophagous, an insects feeding on plants or plant material.

Nect. & Phyto: Insects their larvae feeds on the plant and the adult feeds on the nectar.

Nect. & Pre: Insects, their larvae feeds on the insects and the adult often feeds on the nectar

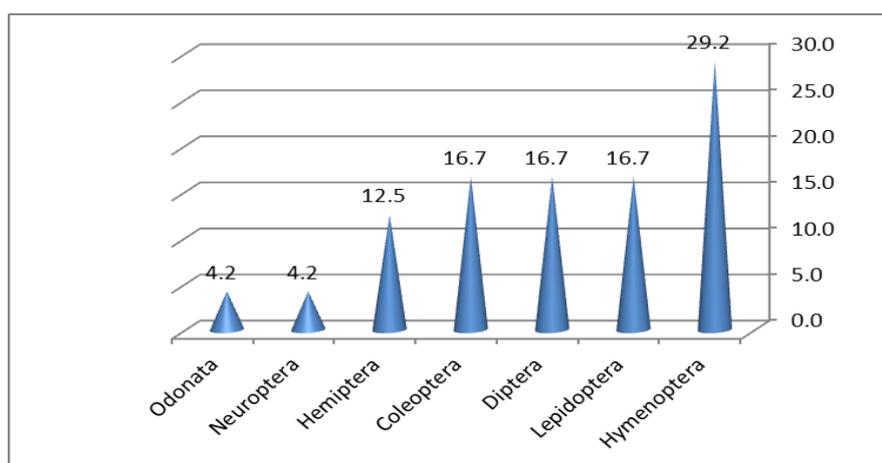


Fig. 1. Percentage of different insects order visit Egyptian clover during 2017 and 2018

2) Population dynamic of the dominant pollinators visit Egyptian clover flowers

Data graphically in **Fig. 2 and 3** illustrated the population densities of *A. mellifera* and *Megachile* sp. during the two successive Egyptian clover growing seasons, 2016/2017 and 2017/2018.

In the first season 2016/2017 in **Fig. 2** the *Apis mellifera* L. and *Megachile* sp. were detected during the first week of May. The population began to increase gradually to reach its peak which record-

ed 16 and 3 bees/m²/min., respectively on the 4th and 3rd week of May respectively and then decreased gradually to the end of the flowering season.

In the second season 2017/2018, the *Apis mellifera* L. and *Megachile* sp. were detected during the first week of May and then the population began to increase gradually to reach its peak (15 and 5 bees/m²/min.), respectively on the 3rd week of May and then decreased gradually to the end of the flowering season (**Fig. 3**).

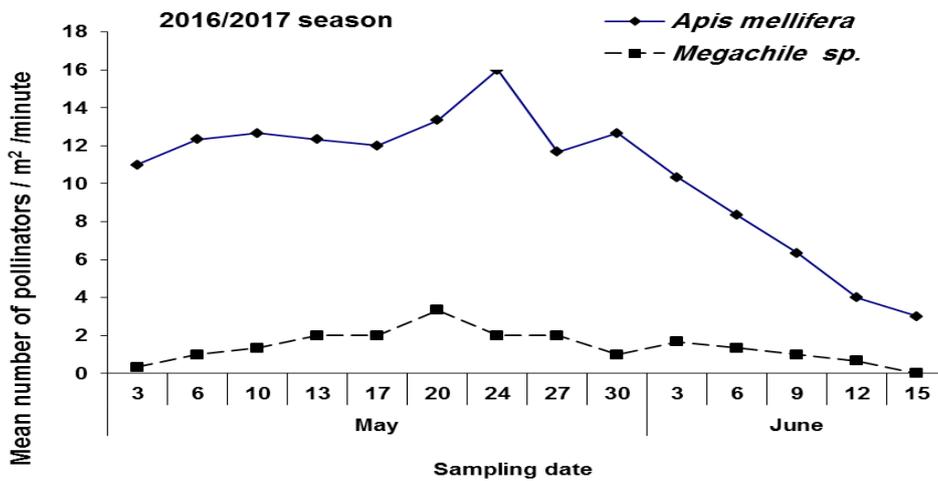


Fig. 2. Population dynamic of the dominant pollinators visited Egyptian clover flowers during 2017 season.

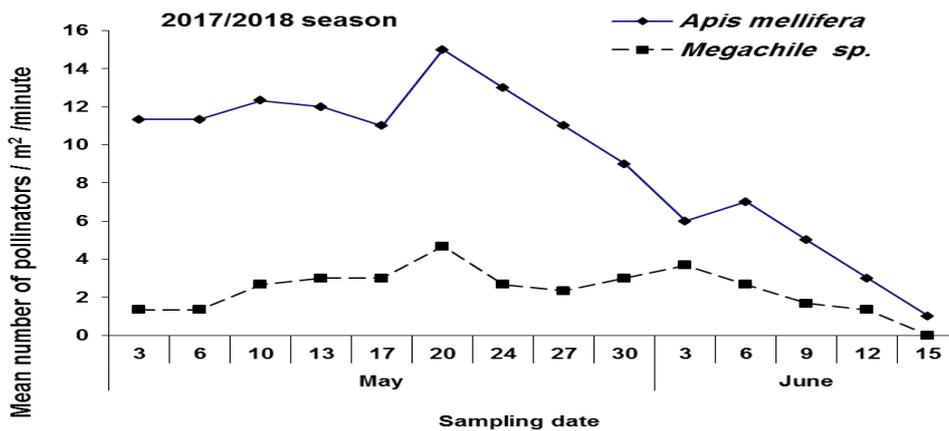


Fig. 3. Population dynamic of the dominant pollinators visited Egyptian clover flowers during 2018 season.

According to **Shimaa Essa (2010)** bee visitation usually began on clover in the beginning of May till the beginning of June in the two studied seasons. The maximum activity was observed on May 19th (8.03 bees/m²/min.), and reached its low-

est activity on June 3rd (2.26 bees/m²/min.) in the 2006 1st, while it was 7.79 bees/m²/min. on May 17th, the minimum was 0.40 bees /m²/min.) on May 5th in the 2nd season.

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3) Diurnal abundance dynamics of Egyptian clover dominant pollinators

During the two seasons, **Table 2** revealed that the highest activity period for *A. mellifera* was detected at 11:00 a.m. However, the lowest activity was found at 3:00 p.m. and 5:00 p.m. in both seasons respectively with insignificant difference between them in the first season.

Whereas the highest activity period for *Megachile sp.* was detected at 1:00 p.m., followed signif-

icantly by 11:00 a.m. and 3:00 p.m. However, the lower activity was found at 7:00 a.m.

These data were in agreement with those of **Ibrahim and Selim (1967)** reported that foraging activity reached its peak between 10 a.m. to 4 p.m. on Egyptian clover. **Shimaa Essa (2010)** reported that Egyptian clover showed a variation in number of forages visiting the flowers during the time of the day, but, it reached its peak in the first season at 8 a.m. and 10 a.m. In the second season it was observed at 2 p.m. and 4 p.m.

Table 2. Number of bees /m² / min. on Egyptian clover flowers at different hours of the day during 2017 and 2018 seasons.

Pollinator	Season	7:00 a.m.	9:00 a.m.	11:00 a.m.	1:00 p.m.	3:00 p.m.	5:00 p.m.	F. value
<i>A. mellifera</i>	2016/17	7.10 d	8.05 c	10.43 a	9.21 b	4.07 e	4.45 e	406.46
	2017/18	6.45 c	7.17 b	9.14 a	7.00 b	4.24 d	2.40 e	251.65
<i>Megachile sp.</i>	2016/17	0.24 d	0.64 c	1.40 b	2.09 a	1.59 b	0.57 c	109.47
	2017/18	0.07 d	0.86 c	2.38 b	3.24 a	2.45 b	0.76 c	96.14

Means in the same row followed by different letters are significantly different (L.S.D Test at 0.05).

3) Effect of honeybees on the Egyptian clover seed yield

a) Number of seeds per head

The analysis of the data in **Fig. 4** revealed that the insect pollination had a significant effect on the number of seeds per head in the two seasons of the study were 52.13 and 55.60, respectively. The non-caged treatment produced the highest mean number of seeds per head followed by the caged with honeybee treatment were 48.15 and 43.85 seeds / head, respectively, in 2016/2017 season, and 51.10 and 46.10 seeds / head, respectively, in 2017/2018 season. On the other hand the lowest mean was recorded in a cage without honeybee treatment were 13.20 and 10.85 seeds/head in both seasons, respectively. From the above data, it was clear that the wild pollinators may play an essential role in clover pollination under experimental conditions.

These data were in agreement with those of **Bondok et al (2016)** found that Maximum Egyptian clover seed yield (2346.6 seeds/40 head) was observed with honey bee pollination six combs followed by four combs (2250.0 seeds) and two combs (1826.6 seeds). Still the lowest seed yield was found in field without insect pollinators.

Jat et al (2014b) observed that maximum seed yield (2662.3 seeds) was observed in honey bee

pollination with 8 combs followed by 4 combs (2373.8 seeds), open pollination (2316.3 seeds) and 2 combs (2235.5 seeds). Still lower yield of (2103.0 seeds) was found in hand pollination treatment that was significantly higher than that without insect pollinator's treatment (1114.2 seeds).

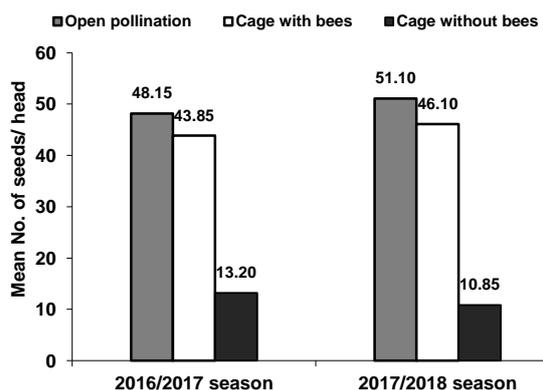


Fig. 4. Mean number of Egyptian clover seeds/head at different modes of pollination during 2017 and 2018 seasons.

According to **Cecen et al (2007)** the highest seed yield of white clover, *Trifolium repens* L. was found in the caged honeybee treatment (46.2 kg/ha) followed by caged bumblebees (37.3kg/ha),

open-pollinated 25.7kg/ha) and pollinator excluded (1.37kg/ha).

Sharma and Singh (2003) found that seed yield in open pollinated plants ranged from 19.6-70.5 seeds per flower head compared to only 0.3-0.6 seeds where insects were excluded (caged).

b) 1000-seed weight

Data illustrated in Fig. 5 revealed that the insect pollination had a significantly effect on the number of seeds per head in the two seasons of the study (F. value was 9.92 and 16.11, respectively). The non.-caged treatment produced the highest mean number of seeds per head followed insignificantly by the caged with honeybee treatment with 3.50 and 3.40 seeds/ head, respectively, in 2016/2017 season, and 3.90 and 3.80 seeds/ head, respectively, in 2017/2018 season. On the other hand, the lowest mean was recorded in a cage without honeybee treatment with 2.75 and 2.55 seeds / head in both seasons, respectively. From the above data, it was clear that the honeybee was efficient pollinator of clover under experiment conditions.

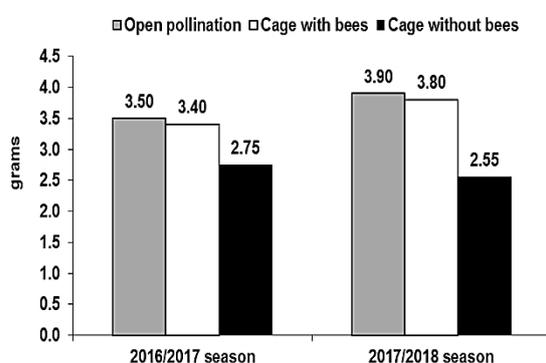


Fig. 5. Mean weight (g) of 1000 seeds at different modes of pollination during 2017 and 2018 seasons.

These data were in agreement with those of Bondok et al (2016) whom founded that minimum 1000-seed weight with without insect pollination was observed (2.56 g). The 1000 seed weight of bee Pollination-four Frame, six Frame and, bee Pollination two Frame were 3.56, 3.30, 3.80 g, respectively. Also, Jat et al (2014b) observed that Minimum 1000-seed weight was in without insect pollination (2.64 g). Whereas the seed weight of bee pollination four frame (3.30) Hand Pollination (3.20) bee pollination two frame (3.17) and open pollination (3.03), the heaviest seeds were record-

ed in, bee pollination eight frame (3.62 g/1000 grains). Singh et al (2012) reported that 1000-seed weight (2.47g) in plots caged with *A.mellifera* colony compared to without insect pollination (2.22g).

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دور الملقحات في تلقيح البرسيم المصري مع الاهتمام بدور نحل العسل في محافظة سوهاج- مصر

[77]

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مع عدم وجود فرق معنوي في الموسم الأول، في حين كانت أعلى فترات النشاط للنحل البري خلال الساعة 1 مساءً، بينما كانت الساعة 7 صباحاً هي أقل فترات النشاط لهذه الحشرة خلال موسمي الدراسة. وأوضحت النتائج أن النباتات التي لم يتم تغطيتها وعزلها عن الحشرات أعطت أعلى متوسط لعدد البذور للنورة يليها النباتات المغطاة مع وجود نحل العسل وكانت النباتات المغطاة وبدون نحل العسل هي الأقل بمتوسط (48,15 و 43,85 و 13,20 / بذرة / نورة) و (51,10 و 46,10 و 10,85 / بذرة / نورة) خلال موسمي الدراسة على الترتيب. وأوضحت النتائج أيضاً أن النباتات المغطاة وبدون نحل العسل أعطت أقل متوسط وزن للألف بذرة، بينما أعطت النباتات الغير مغطاة أعلى وزن بمتوسط (2,75 و 2,55 جم / 1000 بذرة) و (3,50 و 3,90 جم / 1000 بذرة) خلال موسمي الدراسة على الترتيب.

الكلمات الدالة: البرسيم المصري، محصول البذور، الملقحات، النحل

الموجز

تهدف الدراسة إلى حصر أنواع الحشرات الملقحة الزائرة لمحصول البرسيم المصري خلال موسمي التزهير 2017 و 2018 مع بيان أهميتها وخاصة أهمية دور نحل العسل في تلقيح هذه النباتات. أوضحت النتائج أن الحشرات الزائرة للبرسيم المصري خلال فترة الإزهار تتبع 22 جنس حشري تنتمي إلى 16 عائلة تتبع 7 رتب حشرية وتم تقسيمها إلى حشرات تتغذى على النباتات وحشرات تتغذى على الرحيق وحشرات مفترسة. وكان من أهم الأنواع التي تتواجد بشكل يومي على أزهار البرسيم المصري هي نحل العسل والنحل البري *Megachile* sp. حيث تزور هذه الحشرات أزهار البرسيم بداية من الأسبوع الأول من شهر مايو إلى الأسبوع الثاني من شهر يونيو. وتم تسجيل أعلى فترة لنشاط نحل العسل خلال الساعة 11 صباحاً، بينما كانت الساعة 3 و 5 مساءً هي أقل فترات النشاط للحشرة في موسمي الزراعة علي التوالي