



Original article

Nectar and pollen sources for honeybees in Kafrelsheikh province of northern Egypt

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ABSTRACT

This study was conducted at the apiary of the Beekeeping Research Section at the Sakha Agricultural Research Station, ARC, Kafrelsheikh, and other apiaries in Kafrelsheikh province, during two successive years 2015 and 2016. The study aimed to survey nectar and pollen floral resources in Kafrelsheikh province. Ninety seven plant species belonging to 33 families were recorded as nectar sources, and 82 plant species belonging to 36 families were recorded as pollen sources during the whole year. The largest amount of monthly trapped pollen was obtained during May followed by August. It can be concluded that, beekeepers in Kafrelsheikh province can harvest good honey yield at the end of blooming seasons of citrus (*Citrus* spp.) during March and April, Egyptian clover (*Trifolium alexandrinum* L.) during May and June, loofah (*Luffa aegyptiaca* Mill.) during June to October, cotton (*Gossypium* spp.) during July and August, and banana (*Musa* spp.) during August and September. They also, could be trapping pollen loads collected from faba bean (*Vicia faba* L.) and flax (*Linum usitatissimum* L.) during January to March, date palm (*Phoenix dactylifera* L.) during March and April, Egyptian clover during May and June, summer seed watermelon (*Citrullus lanatus* var. *colothynthoides* L.) during June and July, loofah and maize (*Zea mays* L.) during June to November.

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1. Introduction

The main honey flow seasons in Egypt are citrus during March and April, Egyptian clover during April to June, and cotton during July and August (Taha, 2005). In addition, two secondary honey flow seasons: loofah during June to October (Taha et al., 2006), and banana during August and September (Taha, 2007) were recorded in Kafrelsheikh province. Long gaps in the availability of bee floral resources between the flow seasons affect the growth and productivity of bee colonies (Taha, 2000, 2005). During such floral dearth periods, particularly when pollen is not available, colonies gradually use up stored resources within the combs in

their nests, while the queens stop laying eggs and the colonies become weak (Manning, 2008; Taha and Al-Kahtani, 2013). Such colonies use up a major part of nectar and pollen collected directly after the dearth for buildup of colony population. For beekeepers, this process is destructive for their business. Honeybee colonies should be populous in order to store surplus nectar, which is then harvested (Taha and Al-Kahtani, 2013). Beekeepers usually provide their colonies with artificial feeding including sugar syrup and pollen substitutes/supplements during dearth periods (Taha, 2015c). However, no artificial feeds have been found equivalent to nectar and pollen (Mohanna, 1989). The knowledge on the major floral resources lead beekeepers to maintain colony strength, economize the cost of feeding, and harvest good honey yield (Carol, 1999; Taha, 2005, 2015a).

In tropical and sub-tropical areas, bee floral resources are available around the year, and the activity of honeybee colonies in gathering nectar and/or pollen is continued throughout the year (Neupane and Thapa, 2005). However, the foraging activities of honeybees for pollen are greatly influenced by weather factors and availability of pollen (Taha and Al-Kahtani, 2013; Taha, 2014). It is very useful for beekeepers to have a knowledge on nectar and/or pollen floral resources in their areas, that's could help

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them to plan for managing their colonies, and they may be decided to move it to another area rich with nectar and pollen floral resources during certain periods to have good honey yield, producing bee swarms, or queen production (Taha, 2005, 2015a).

Studies on nectar and/or pollen plants for honeybees were conducted in Brazil (Luz and Barth, 2012); in Costa Rica (Freitas, 1994); in Bulgaria (Atanassova and Lazarova, 2010); in Egypt (Taha, 2000; Helal et al., 2003; Fathy, 2008; Ismail et al., 2013; Abou-Shaara, 2015; Esmael et al., 2016); in Germany (Köppler et al., 2007; Beil et al., 2008); in India (Singh, 2003); in Iran (Mossadegh, 1990); in Italy (Fortunato et al., 2006); in Mexico (Villanueva, 1989); in Nibal (Paudyal and Gautam, 2011); in Nigeria (Dukku, 2003); in Palestine (Reyahi, 1999); in Philippines (Payawal et al., 1991); in Poland (Wróblewska et al., 2010); in Saudi Arabia (Taha, 2013, 2015a,b; Taha et al., 2016; Adgaba et al., 2017; Al-Kahtani et al., 2017; Taha et al., 2019); in Spain (Seijo et al., 1994); in Turkey (Bilisik et al. 2008); in USA (Baum et al., 2011).

The present study aimed to survey major and minor sources of nectar and/or pollen for honeybees in Kafrelsheikh province, northern Egypt throughout the year. The second goal was to throw the light on the periods in which beekeepers can harvesting honey yield, and/or trapping pollen loads collected from the major sources.

2. Materials and method

The present study was carried out at the apiary of the Beekeeping Research Section at Sakha Agricultural Research Station, ARC, Kafrelsheikh, and other apiaries in Kafrelsheikh province, northern Egypt throughout two successive years, from January 2015 to December 2016. Kafrelsheikh lies at latitude 31°06'42"N and longitude 30°56'45"E at an altitude of 17 m above sea level. It comprises 10 cities: Metoubes, Sidi Salem, Fuwwah, Desouk, Qallin, Kafrelsheikh, El-Reyad, Beila, El-Hamool, and Baltim.

Fresh flowers were collected from the plants as buds before anthesis, and reference slides were prepared according to Louveaux et al. (1978). The anthers were washed out 3 times in a watch glass filled with ether and then were dried. The pollen grains were transferred to a slide and spread out. A drop of fructose solution (20 g fructose + 0.5 g crystallized phenol in 100 ml of distilled water) was added to facilitate the transferring, and accelerate the swelling of the pollen grains. The preparation was dried on a warming plate at 40 °C and mounted with glycerine gelatine. This procedure was done for the pollen grains of each plant species. The prepared reference slides were stored in a refrigerator.

Five colonies (each 10 combs) of hybrid Carniolan (*Apis mellifera carnica* Pollmann) honeybees were selected in each city to study the fluctuation of collected bee-pollen throughout the year in Kafrelsheikh province. All colonies were approximately in the same strength (brood combs, stored food, and adult bee population). Pollen traps with efficiency of 25% were fitted on the entrance of the hives in each city. Pollen loads were collected from pollen traps every two days. Pollen loads were dried at room temperature in a shady place for two hrs to make the separation easy. The pollen loads were hand-sorted according to their color and appearance, then referred to their sources, and were weighted using an electrical balance. Microscopical examinations were conducted to identify the floral origin of pollen grains according to their shape and size by comparing with the previously prepared reference pollen slide.

Recording of all plant species which were observed to be visited by honeybee workers was done throughout the year in the ten regions represented Kafrelsheikh province. Unidentified plant species were collected, transferred to the laboratory, then were

identified and recorded. Each source was identified by its scientific name and botanical family. Average date of the blooming period of each plant and the value for bees as a source of nectar and/or pollen were recorded.

Data were statistically analyzed by the analysis of variance (ANOVA) using PROC GLM ver. 9.1.3 SAS® software computer program (SAS Institute, 2003). Means of monthly collected bee-pollen were compared using Least Significant Difference (LSD) tests (α : 0.05).

3. Results

Data listed in Table 1 showed that 110 plant species belonging to 39 plant families were recorded as pollen and/or nectar floral resources in Kafrelsheikh province throughout 2015 and 2016. Ninety seven plant species belonging to 33 families were recorded as nectar sources and 82 plant species belonging to 36 families were recorded as pollen sources during the whole year. The most important species for honeybees in Kafrelsheikh province were faba bean (*Vicia faba* L.), flax (*Linum usitatissimum* L.), peach (*Prunus persica* L.) citrus (*Citrus* spp.), date palm (*Phoenix dactylifera* L.), Egyptian clover (*Trifolium alexandrinum* L.), guava (*Psidium guajava* L.), summer seed watermelon (*Citrullus lanatus* var. *colothynthoides* L.), loofah (*Luffa aegyptiaca* Mill.), maize (*Zea mays* L.), cotton (*Gossypium* spp.), sunflower (*Helianthus annuus* L.), banana (*Musa* spp.). The highest numbers (64 spp.) of blooming species were recorded during March, while the lowest numbers (7 spp.) were recorded during January.

As shown in Table 2 faba bean, Egyptian clover, summer seed watermelon, and cotton were recorded as major nectar floral resources in all regions of Kafrelsheikh province. Faba bean, Egyptian clover, summer seed watermelon, and maize were recorded as major pollen floral resources in all regions of Kafrelsheikh province. Citrus was recorded as a major nectar, and minor pollen floral resource in Metoubes, Fuwwah, and Desouk regions. Banana was recorded as a honey plant in Fuwwah, and Desouk regions. Loofah was recorded as a major floral resource of nectar and pollen in Metoubes region. In Metoubes and Baltim regions, guava was recorded as a major nectar and pollen floral resource, while date palm was recorded as a major pollen floral resource. Sunflower was recorded as a major source of nectar and pollen in Sidi Salem, Qallin and Kafrelsheikh regions, and as a minor source in the others regions.

The average yearly amounts of collected bee-pollen were 2.866 and 2.780 kg/colony in 2015 and 2016, respectively. Significant ($P < .01$) variations were found among amounts of trapped pollen loads during months throughout the year. The largest amounts of collected bee-pollen were obtained during May (440.77 and 425.33 g/colony), followed by August (327.73 and 335.62 g/colony), then March (305.33 and 284.80 g/colony), while the lowest amounts of trapped pollen loads were obtained during January (131.92 and 115.66 g/colony), followed by December (136.36 and 125.65 g/colony) in 2015 and 2016, respectively (Fig. 1).

4. Discussion

The survey of bee plants in Kafrelsheikh province showed that 110 plant species were visited by honeybees (*A. mellifera* L.); worker bees can collect nectar from 97 species, and can collect pollen from 82 floral resources during the whole year. Previous studies in Egypt showed that, there were 39 bee forages belonging to 15 families in Kafrelsheikh region (Taha, 2005), 26 pollen species in 15 families in Dakahlia (Fathy, 2008), 24 pollen sources belonging to 16 families at Fayoum (Ismail et al., 2013), and 65 bee plants

Table 1
Nectar and pollen floral resources in Kafrelsheikh province during 2015 and 2016 years.

	Latin name	Common name	Family	Flowering period	Source	
					Nectar	Pollen
1	<i>Vicia faba</i> L.	Faba bean	Fabaceae	January–March	++	++
2	<i>Lupinus albus</i> L.	White lupin	Fabaceae	January–March	+	+
3	<i>Trigonella foenum-graecum</i> L.	Fenugreek	Fabaceae	January–March	+	+
4	<i>Linum usitatissimum</i> L.	Flax	Linaceae	January–March	++	++
5	<i>Ocimum</i> spp.	Basil	Lamiaceae	January–December	+	+
6	<i>Prunus persica</i> L.	Peach	Rosaceae	February–March	++	++
7	<i>Prunus armeniaca</i> L.	Apricot	Rosaceae	February–March	+	+
8	<i>Anagallis arvensis</i> L.	Scarlet pimpernel	Myrsinaceae	February–March	+	+
9	<i>Citrus limon</i> (L.) Osbeck	Eureka lemon	Rotaceae	February–March	+	+
10	<i>Citrus aurantiifolia</i> Swingle	Key lime	Rotaceae	February–March	+	+
11	<i>Citrus latifolia</i> (Yu.Tanaka) Tanaka	Persian Lime	Rotaceae	February–March	+	+
12	<i>Pisum sativum</i> L.	Pea	Fabaceae	February–April	+	+
13	<i>Avena fatua</i> L.	Wild oat.	Poaceae	February–March	–	+
14	<i>Setaria viridis</i> (L.) P.Beauv	Green foxtail	Poaceae	February–March	–	+
15	<i>Sisymbrium irio</i> L.	Thumble mustard	Brassicaceae	February–April	+	+
16	<i>Raphanus sativus</i> L.	Radish	Brassicaceae	February–April	+	+
17	<i>Eruca sativa</i> Mill.	Rocket	Brassicaceae	February–April	+	+
18	<i>Melilotus siculus</i> All.	Yellow sweet clover	Fabaceae	February–April	–	+
19	<i>Melilotus indicus</i> All.	Sour clover	Fabaceae	February–April	–	+
20	<i>Medicago hispida</i> Gaertn.	Bur clover	Fabaceae	February–April	–	+
21	<i>Malus domestica</i> Borkh. nom. illeg.	Apple	Rosaceae	February–April	–	+
22	<i>Salix safsaf</i> Forssk	Egyptian willow	Salicaceae	February–April	–	+
23	<i>Casuarina equisetifolia</i> L.	Casuarina	Casuarinaceae	February–April	–	+
24	<i>Persea americana</i> Mill.	Avocado	Lauraceae	February–April	+	+
25	<i>Anethum graveolens</i> L.	Dill	Asteraceae	February–May	+	+
26	<i>Petroselinum crispum</i> Mill.	Parsley	Asteraceae	February–May	+	+
27	<i>Senecio vulgaris</i> L.	Groundsel	Asteraceae	February–May	+	+
28	<i>Malva sylvestris</i> L.	High mallow	Malvaceae	February–May	+	+
29	<i>Ricinus communis</i> L.	Castor bean	Euphorbiaceae	February–May	+	+
30	<i>Coriandrum sativum</i> L.	Coriander	Apiaceae	February–October	+	+
31	<i>Barasica oleracea</i> var. <i>capitata</i> L.	Cabbage	Brassicaceae	February–April	+	+
32	<i>Barasica rapa</i> L.	Turnip	Brassicaceae	February–April	+	+
33	<i>Barasica napus</i> L.	Rape	Brassicaceae	February–April	+	+
34	<i>Barasica nigra</i> Koch	Wild mustard	Brassicaceae	March–May	+	+
35	<i>Pyrus malus</i> L.	Apple	Rosaceae	March–April	+	+
36	<i>Pyrus communis</i> L.	Pear	Rosaceae	March–April	+	+
37	<i>Citrus sinensis</i> Osbeck	Orange	Rotaceae	March–April	++	+
38	<i>Citrus reticulata</i> Blanco	Mandarin orange	Rotaceae	March–April	++	+
39	<i>Citrus aurantium</i> Linn	Sour orange	Rotaceae	March–April	+	+
40	<i>Phoenix dactylifera</i> L.	Date palm	Arecaceae	March–April	–	++
41	<i>Mangifera indica</i> L.	Mango	Anacardiaceae	March–April	+	+
42	<i>Punica granatum</i> L.	Pomegranate	Lythraceae	March–April	+	+
43	<i>Papaver rhoeas</i> L.	Common poppy	Papaveraceae	March–April	+	+
44	<i>Borago officinalis</i> L.	Borage	Boraginaceae	March–April	+	+
45	<i>Matricaria chamomilla</i> L.	Chamomile	Asteraceae	March–April	+	+
46	<i>Rosmarinus officinalis</i> L.	Rosemary	Lamiaceae	March–April	+	+
47	<i>Emex spinosus</i> L.	Devil's thorn	Polygonaceae	March–April	+	+
48	<i>Oxalis griffithii</i> Edgew. & Hook.	Pink doubl flower	Oxalidaceae	March–April	+	+
49	<i>Hordeum murinum</i> L.	Wall barley	Poaceae	March–April	–	+
50	<i>Urtica urens</i> L.	Nettle	Urticaceae	March–April	+	+
51	<i>Lolium multiflorum</i> Lam.	Ryegrass	Poaceae	March–April	–	+
52	<i>Nerium oleander</i> L.	Nerium	Apocynaceae	March–April	+	+
53	<i>Silybum marianum</i> L.	Star-thistle	Asteraceae	March–May	+	+
54	<i>Morus alba</i> L.	White mulberry	Moraceae	March–May	+	+
55	<i>Morus nigra</i> L.	Mulberry	Moraceae	March–May	+	+
56	<i>Alcea rosea</i> L.	Hollyhock	Malvaceae	March–September	+	–
57	<i>Convolvulus arvensis</i> L.	Field Bindweed	Convolvulaceae	March–October	+	+
58	<i>Libbia nodiflora</i> L.	Lebya	Verbenaceae	March–October	+	+
59	<i>Petunia</i> spp.	Petunia	Solanaceae	March–October	+	+
60	<i>Solanum lycopersicum</i> L.	Tomato	Solanaceae	March–December	+	+
61	<i>Solanum melongena</i> L.	Eggplant	Solanaceae	March–December	+	+
62	<i>Capsicum annuum</i> L.	Chili pepper	Solanaceae	March–December	+	+
63	<i>Capsicum annuum</i> var. <i>glabriusculum</i> Dunal	Chiltepin	Solanaceae	March–December	+	+
64	<i>Zantedeschia aethiopia</i> (L.) Spreng.	Arum lily	Araceae	April–May	+	+
65	<i>Albizia julibrissin</i> Durazz	Pink siris	Fabaceae	April–May	+	+
66	<i>Melaleuca viminalis</i> (Sol. ex Gaertn.) Byrnes	Weeping bottlebrush	Myrtaceae	April–May	+	+
67	<i>Acacia saligna</i> (Labill.) H.L. Wendl	Coojong	Fabaceae	April–May	+	+
68	<i>Tanacetum parthenium</i> (L.) Sch. Bip.	Feverfew	Asteraceae	April–May	+	+
69	<i>Olea europaea</i> L.	Olive	Oleaceae	April–May	+	+
70	<i>Euphorbia milii</i> Des Moul	Christ thorn	Euphorbiaceae	April–May	+	+
71	<i>Opuntia ficus-indica</i> (L.) Mill.	Barbary fig	Cactaceae	April–May	+	+
72	<i>Cucumis melo</i> var. <i>cantalupensis</i> Naudin	Cantaloupe	Cucurbitaceae	April–May	++	++
73	<i>Citrullus lanatus</i> var. <i>lanatus</i> (Thunb.) Matsum. & Nakai	Watermelon	Cucurbitaceae	April–May	++	++

Table 1 (continued)

	Latin name	Common name	Family	Flowering period	Source	
					Nectar	Pollen
74	<i>Ammi visnaga</i> L.	Tooth pick	Asteraceae	April–May	+	+
75	<i>Cichorium intybus</i> L.	Chicory	Asteraceae	April–May	+	+
76	<i>Trifolium alexandrinum</i> L.	Egyptian clover	Fabaceae	April–June	++	++
77	<i>Cucurbita pepo</i> Thunb	Squash	Cucurbitaceae	April–September	+	+
78	<i>Portulaca oleracea</i> L.	Purslane	Portulacaceae	April–October	–	+
79	<i>Pluchea dioscoridis</i> (L.) DC.	Camphorweeds	Asteraceae	April–October	+	+
80	<i>Hibiscus rosa-sinensis</i> L.	Chinese hibiscus	Malvaceae	May–June	+	–
81	<i>Ammi</i> spp.	Celery	Apiaceae	May–June	+	+
82	<i>Malvaviscus arboreus</i> Cav.	Sleeping hibiscus	Malvaceae	May–June	+	–
83	<i>Carduus acanthoides</i> L.	Wetted thistle	Asteraceae	May–June	+	+
84	<i>Pelargonium zonale</i> (L.) L'Hér. ex Aiton	Horse-shoe pelargonium	Geraniaceae	May–June	+	+
85	<i>Delonix regia</i> (Boj. ex Hook.) Raf	Royal poinciana	Fabaceae	May–June	+	+
86	<i>Aptenia cordifolia</i> (L.f.) N.E.Br	Baby sun rose	Aizoaceae	May–June	+	+
87	<i>Leucaena leucocephala</i> (Lam.) de Wit	White leadtree	Fabaceae	May–June	+	+
88	<i>Cichorium pumilum</i> Gacq	Willd chicory	Asteraceae	May–June	+	+
89	<i>Psidium guajava</i> L.	Guava	Myrtaceae	May–July	+	++
90	<i>Ipomoea carnea</i> Jace.	Pink morning glory	Convolvulaceae	May–December	+	–
91	<i>Citrullus lanatus</i> var. <i>colothynthoides</i> L.	Summer seed watermelon	Cucurbitaceae	June–July	+	++
92	<i>Duranta</i> spp.	Duranta	Verbenaceae	June–August	+	+
93	<i>Abelmoschus esculentus</i> (L.) Moench	Okra	Malvaceae	June–September	+	–
94	<i>Cucumis sativus</i> L.	Cucumber	Cucurbitaceae	June–October	+	+
95	<i>Luffa aegyptiaca</i> Mill.	Loofah	Cucurbitaceae	June–November	++	++
96	<i>Zea mays</i> L.	Maize or corn	Poaceae	June–November	–	++
97	<i>Gossypium</i> spp.	Cotton	Malvaceae	July–August	++	–
98	<i>Origanum majorana</i> L.	Marjoram	Lamiaceae	July–August	+	+
99	<i>Hibiscus cannabinus</i> L.	Kenaf	Malvaceae	July–August	+	–
100	<i>Helianthus annuus</i> L.	Sunflower	Asteraceae	July–August	++	++
101	<i>Sesamum indicum</i> L.	Sesame	Pedaliaceae	July–August	++	++
102	<i>Vigna unguiculata</i> (L.) Walp.	Cowpea	Fabaceae	July–August	+	+
103	<i>Musa</i> spp.	Bananas	Musaceae	August–September	++	–
104	<i>Oryza sativa</i> L.	Rice	Poaceae	August–September	–	+
105	<i>Schinus terebinthifolius</i> Radd.	Brazilian pepper	Anacardiaceae	September–October	+	+
106	<i>Phaseolus vulgaris</i> L.	Bean	Fabaceae	September–October	+	+
107	<i>Pisum sativum</i> L.	Pea	Fabaceae	October–January	+	+
108	<i>Eucalyptus globulus</i> Labill	Eucalyptus	Myrtaceae	October–April	+	+
109	<i>Eriobotrya japonica</i> (Thunb.) Lindl.	Loquat	Rosaceae	November–December	+	+
110	<i>Tecoma stans</i> (L.) Juss.ex Kunth	Trumpet flower	Bignoniaceae	November–December	+	+

++ Major source. + Minor source. – Not source.

Table 2

Major nectar and/or pollen floral resources in Kafrelsheikh province in 2015 and 2016.

Floral resources	Metoubes	Sidi Salem	Fuwwah	Desouk	Qallin	Kafrelsheikh	El-Reyad	Beila	El-Hamool	Baltim
Citrus	++	–	++	++	–	–	–	–	–	++
Egyptian clover	++	++	++	++	++	++	++	++	++	++
Loofah	++	+	+	+	+	+	+	+	+	+
Cotton ^N	++	++	++	++	++	++	++	++	++	+
Banana ^N	+	+	++	++	+	+	+	+	+	+
Faba bean	++	++	++	++	++	++	++	++	++	++
Flax	+	++	++	+	++	++	++	++	++	++
Peach	++	–	++	++	–	–	–	–	–	–
Date palm ^P	++	+	+	+	+	+	+	+	+	++
Guava	++	+	+	+	+	+	+	+	+	++
Summer seed watermelon	++	++	++	++	++	++	++	++	+	++
Sunflower	+	++	+	+	++	++	+	+	+	+
Maize ^P	++	++	++	++	++	++	++	++	++	++
Watermelon	+	+	+	+	+	+	+	+	+	++

++ Major source. + Minor source. – Not source. ^N Source for nectar not for pollen, ^P Source for pollen not for nectar.

belonging to 25 plant families in Alexandria and El-Beheira provinces (Esmael et al., 2016). In India, more than 60 plant species were visited by *A. cerana*, five species were potential sources of nectar and five species were sources for pollen (Nehru et al., 1988). In Iran, 173 bee plants belonging to 32 families were recorded; 89 plants produce surplus honey and 28 species as major pollen sources (Mossadegh, 1990). In Mexico, 102 plant species were visited by the bees (Villanueva, 1989). In Saudi Arabia, 79 bee plant species belonging to 24 botanical families were recorded as nectar and/or pollen sources in Al-Ahsa province (Taha, 2015a),

meanwhile 182 species from 49 plant families were identified as bee forages in Al-Baha region (Adgaba et al., 2017).

Of the total 110 species were recorded, 76 (69.10%) were herbs, 29 (26.36%) trees, and 5 (4.54%) shrubs. The main 5 sources of honey were classified as 3 herbs (*T. alexandrinum*, *L. aegyptiaca*, and *Gossypium* spp.) and two trees (*Citrus* spp., and *Musa* spp.). Meanwhile, all major pollen floral resources were classified as herbs except for date palm, guava and peach were trees. All major floral resources of nectar and/or pollen were cultivated plants. Similar results were reported by Taha (2000, 2005), Fathy (2008), Ismail

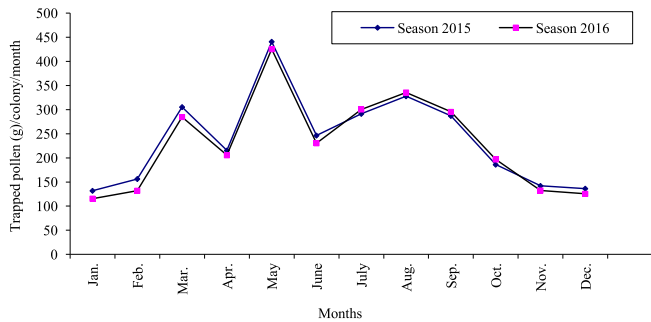


Fig. 1. Seasonal fluctuation of collected bee-pollen in Kafrelsheikh province during 2015 and 2016.

et al. (2013), Esmael et al. (2016) in Egypt, and Taha (2015a) in the Al-Ahsa oasis of eastern Saudi Arabia. Kafrelsheikh is an Agricultural province, that's could explains why all of major floral resources of nectar and/or pollen in this province were classified as cultivated plants. There were some wild plants visited by bees, but non of them is major source either of nectar or pollen.

Of the total 110 species were recorded as bee plants only five species (*Citrus* spp., *T. alexdrinum*, *L. aegyptiaca*, *Gossypium* spp., and *Musa* spp.) represented 4.55% of the identified plants produced surplus honey in Kafrelsheikh province. This percentage is higher than that (3.30%) for bee plants in Al-Baha region (Adgaba et al., 2017), and that (3.80%) in Al-Ahsa province (Taha, 2015a) in Saudi Arabia, and that (1.6%) of world bee plants (Crane, 1990), while our percentage is too low compared with that (51.44%) of Villanueva (1989) in Iran. Beekeepers in Kafrelsheikh province usually harvest honey yield during the blooming seasons of *Citrus* spp., *T. alexdrinum* and *Gossypium* spp. (Taha, 2000, 2005), *L. aegyptiaca* (Taha et al., 2006) and *Musa* spp. (Taha, 2007). In Saudi Arabia, *Medicago sativa* L., *Ziziphus* spp. and *Citrus* spp. were the dominant sources of nectar, while *Cucurbita pepo* Thunb, *Ph. dactylifera* L., *Helianthus annuus* L., *M. sativa* L. and *Brassica napus* L. were the main sources of pollen in Al-Ahsa province (Taha, 2015a,b). Besides, the major sources of nectar in Al-Baha region were *Z. spina-christi* L., *Acacia tortilis* (Forssk) Hayne, *A. asak*, *Lavandula dentata* L., and *Hypoestes forskoolii* (Adgaba et al., 2017). In USA, 7 bee plants non-Lamiaceae and nine Lamiaceae species were recorded as nectar-producing plants (Widrechner and Senechal, 1992).

Faba bean and flax were bloomed during the period from January to March in most parts of Kafrelsheikh province. Their flowers were produced much pollen and nectar. The extra-floral nectaries of faba bean were produced nectar before flowering starts and this continues through and to the end of flowering (Kirk, 2004). Peach was bloomed during early spring, and honeybees were collected nectar and pollen from flowers. These plants did not produce surplus honey, but they are very important for building up the colonies and swarms production. Date palm was flowered during March and April, male trees produced more pollen. It considered an important source of pollen in Metoubes (Taha, 2005) and Baltim regions. Summer seed watermelon was bloomed during a dearth period between Egyptian clover and cotton flow seasons so, it was served on maintaining the colony strength and economizing the cost of feeding during this period (Taha and Bayomi, 2009). Guava was bloomed from May to July and considered good source of nectar and pollen in Metoubes and Baltim regions. Sunflower and sesame were bloomed during July and August. They were good sources of nctare and pollen during this period. These results are in lin with the findings of Hussein et al. (1992) in Assiut, Taha (2000, 2005) in Kafrelsheikh, Fathy (2008) in Dakahlia, Ismail et al. (2013) in Fayoum, Esmael et al. (2016) in Alexandria and El-Beheira provinces.

The number of available bee plants throughout the months of the year could be arranged in a descending order: March and April > May > February > June > July and August > September > October > November > December > January. Seven nectar and pollen floral resources were bloomed during January; faba bean and flax were the most important plants for honeybees. During February, 34 pollen and 27 nectar floral resources were recorded; faba bean, flax, and peach were the most beneficial plants for honeybees in this period. Sixty-four bee forage plants were recorded during March and April. The most important sources during March were citrus, faba bean, date palm, peach, and flax. Similar results were recorded by Hussein et al. (1992) in Assiut province, and by Taha (2005) in Kafrelsheikh province. Unfortunately, most of the bloomed plants in April were dried before mid-April. Citrus was the predominant bee flora in April. These results confirmed the findings of Taha (2005). During May, 46 nectar and pollen floral resources were recorded; Egyptian clover was recorded as a major nectar and pollen floral resource. These results are in agreement with those obtained by Hussein et al. (1992) in Assiut, Esmael et al. (2016) in El-Beheira, and Taha (2005) in Kafrelsheikh province. During June, 33 pollen and/or nectar floral resources were recorded. The most abundant species were Egyptian clover, guava, and loofah. Twenty-nine pollen and/or nectar floral resources were recorded throughout July and August; the most abundant species were watermelon, guava, loofah, cotton, banana, sunflower, and maize. These results are in harmony with those obtained by Hussein et al. (1992) in Assiut, and Taha (2005) in Kafrelsheikh province. Twenty-two bee forage plants were recorded during September; loofah, and maize were the most important species. Nineteen taxa were bloomed in October; loofah, and maize were the major sources in this period. Although, 12 plant species flowered in November, and 10 plants in December, it considered dearth period because all of these plants are minor sources of nectar and/or pollen.

The most represented families were Fabaceae (15 spp.), Asteraceae (12 spp.), Brassicaceae and Malvaceae (7 spp.), Cucurbitaceae, Poaceae, Rosaceae and Rutaceae (6 spp.), and solanaceae (5 spp.). They contributed by 63.64% of total bee flora in Kafrelsheikh province. These results are in agreement with those obtained by Zoratti et al. (1995) in Italy, Taha (2005) and Esmael et al. (2016) in Egypt, and Taha (2015a) and Adgaba et al. (2017) in Saudi Arabia, they reported that the most represented families were Asteraceae, Brassicaceae, Cucurbitaceae, Fabaceae, Rosaceae. Besides, the most abundant species in Nigerian honey samples were from Asteraceae and Arecaceae (Adekanmbi and Ogundipe, 2009). Apiaceae, Lamiaceae, and Myrtaceae were represented by 3 spp. The following families: Anacardiaceae, Convolvulaceae, Euphorbiaceae, Moraceae, and Verbenaceae each was represented by two plant species. Moreover, 22 families (Arecaceae, Aizoaceae, Apocynaceae, Araceae, Bignoniaceae, Boraginaceae, Cactaceae, Casuarinaceae, Geraniaceae, Lauraceae, Linaceae, Lythraceae, Musaceae, Myrsinaceae, Papaveraceae, Pedaliaceae, Polygonaceae, Portulacaceae, Oleaceae, Oxalidaceae, Salicaceae, and Urticaceae) were represented by one nectar and/or pollen floral resource.

The monthly weight of trapped pollen loads reflects the activity of honeybee colonies in gathering pollen. Pollen collection is a continuous prosses throughout the year. The colonies started their activities in pollen collection during January, then significant ($P < .01$) increasing occurred during February and reached the first peak during March. Decreasing in pollen collection occurred during April, then increased significantly ($P < .01$) and formed the second and the major peak during May coincided with the flowering period of Egyptian clover, then significant ($P < .01$) decrease occurred during June. Gradually increase occurred during July, and formed the third peak in August, then gradually and significantly ($P < .01$) decrease occurred from September to December. These

results are confirmed by the findings of [Shawer \(1987\)](#), [Fathy \(1996\)](#), [Shawer et al. \(2003\)](#), [Taha \(2005\)](#) in Egypt, [Taha and Al-Kahtani \(2019\)](#) in Saudi Arabia, and [Al-Humyari et al. \(1999\)](#) in Yemen who recorded the maximum area of stored pollen during May. Besides, [Sattigi and Lingappa \(1993\)](#) found the maximum area of stored pollen during March in India. Three peaks of pollen collection were recorded during March, May and August in the Al-Ahsa oasis of eastern Saudi Arabia ([Taha and Al-Kahtani, 2013, 2019; Taha, 2014, 2015a](#)). On contrary, the maximum area of stored pollen was recorded during September in the Island of Hawaii ([Arita and Fujii, 1992](#)). April considered a dearth period in Kafrelsheikh province because of the shortage of pollen and nectar floral resources, as a result of dried of most flowering plants after a short time in April. The decline in pollen collecting during April was recorded in Saudi Arabia ([Taha, 2014, Taha and Al-Kahtani, 2019](#)) due to the presence of bee-eater (*Merops* spp.) birds in the apiary area ([Ali and Taha, 2012](#)). The lowest amount of collected bee-pollen was trapped during January, this may be related to the low number of flowering plants during this period. Similar results were obtained by [Khanbash and Bin Ghodel \(1994\)](#) in Yemen, and [Taha \(2014, 2015a\)](#) in the Al-Ahsa oasis of eastern Saudi Arabia.

5. Conclusion

Based on the present data, it can be concluded that beekeepers at Kafrelsheikh province can obtain high honey yield, during the blooming seasons of citrus (March and April), Egyptian clover (April to June), loofah (June to October), cotton (July and August), and banana (August and September). They can trap pollen loads during the flowering periods of faba bean (January to March), Egyptian clover (April to June), summer seed watermelon (June and July), loofah (June to October), and maize (June to November).

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