

FRUIT TREES AND VEGETABLE PLANTS AS SOURCES OF NECTAR FOR HONEYBEE IN NORTH SINAI

2. CITRUS APPLE AND CANTALOUPE

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ABSTRACT

The present work was carried out to evaluate, citrus, apple and cantaloupe flowers in North Sinai as complete previous study concerning almond and peach orchards. All main fruit and vegetable crops cultivated in North Sinai Governorate. The areas cultivated with the three fore-mentioned crops as well as the numbers of flowers per tree/plant and per feddan were calculated.

The results revealed that, blooming period for citrus trees started on February 25 and finished on April 20, and the blooming peak was found during the period from February 20-22. The maximum volume of nectar and its amount of solid compounds were recorded from 12 at noon till 4 p.m.

The blooming period for blooming apple trees began on January 19 and finished on March 5, and the peak was recorded during the period from February 20-22. The maximum volume of nectaw was recorded at 4 p.m. The same result was obtained for the amount of solid compounds.

It was found that, the blooming period for cantaloupe started on February 25 and finished on April 15, with the blooming peak between 25th – 27th of March. Largest volume of nectar was recorded in flowers picked up during the period from 11 a.m. till 4 p.m. highest amount of solid compounds was recorded at 1 p.m. and its lowest in the morning.

INTRODUCTION

In a previous search, almond and peaches had been studied as sources of nectar for honeybeen colonies in North Sinai Governorate. The present work is a piece of work which complete such study by evaluating the citrus and apple trees, and the cantaloupe plants during their blooming periods to supply honeybee colonies with nectar. Such fruit and vegetable crops, in addition to olive, are considered the principale crops in North Sinai, which may frequently visit by honeybees for collecting nectar and pollen grains. Nectar secretion started at the bud stage and another dehiscence took place during or just after petal opening (Masierowska *et al.*, 1993). The worker bees frequently visited flowers throughout the day and stayed longer on flowers which had been un-visited for a while than on a flower which had been visited recently (Kato, 1988).

The aim of the present work is to complete a previous study by estimating the volume and concentration of nectar in the flowers of citrus and apple trees, and cantaloupe plants during the blooming periods to deviate light to the future of honeybee colonies and their distribution in North Sinai Governorate.

MATERIAL AND METHODS

Experiments were conducted during the blooming periods of citrus and apple orchards and during the blooming period of cantaloupe plants. Three citrus orchards, three apple ones and two cantaloupe fields were selected in Al-Arish locality. From each orchard, 20 trees (either citrus or apple) of the relatively similar age (5-6 years) were chosen to estimate the volume of nectar, determine the quantity of solid compounds in the nectar and its concentration during the day time. All experimental orchards and fields received similar agriculture practices without using any pesticidal chemicals.

For obtaining the nectar secretion from the experimental plants and trees the same procedure previously recorded was applied (El-Bassiouni, 2002). The flowers of each plant species were gathered simultaneously at seven daily times: 10 and 11 a.m., at 12 noon, 1,2,3 and 4 p.m. during the flowering peaks periods which last for seven days.

In laboratory, the nectar was sucked from each flower by glass micropipette, the volume was estimated by a microsyringe and the concentration of total sugar was determined by refractometer. The solid compounds in the nectar was calculated according to the nectar volume and its concentration. The areas cultivated with citrus, apple and cantaloupe were taken from Al-Arish Agricultural Service, Ministry of Agriculture (2001). The obtained data were statistically analyzed.

RESULTS AND DISCUSSION

1. Cultivated area with experimental crops :

Survey was made in Bear El-Abd, Al-Arish, El-Sheikh Zowayed and Rafah to account the areas cultivated with citrus trees, apple trees and cantaloupe plants. The mean number of flowers during the flowering period for each crop was also calculated. The obtained data are recorded in Tables (2-4).

In Table (1), 1537 feddans were cultivated with citrus trees in all experimental localities. The largest area was recorded in Rafah (1070 feddans), followed by Bear El-Abd (237 feddan) and Al-Arish (169 feddans), representing 69.62, 15.42 and 10.99% of the total areas cultivated with citrus trees in North Sinai, respectively. The smallest area (61 feddans, 3.97% of the total areas) was however, found in El-Sheikh Zowayed. The opposite was however, true for cantaloupe crop. In this case, the largest area (1776 feddans) was recorded in El-Sheikh Zowayed, followed by Al-Arish (1255 fedd.) and Rafah (1040 feddans), representing 39.75, 28.09 and 23.27% of the total areas cultivated with cantaloupe in North Sinai, respectively. The smallest area (397 feddans, 8.89% of the total areas) was found in Bear El-Abd.

In case of apple trees, All of cultivated areas in the experimental localities were 384 feddans only in the season of 2001 as 151, 141, 81 and 11 feddans, in El-Sheikh Zowayed, Al-Arish, Rafah and Bear El-Abd

respectively. The mean number of flowers per trees, as well as the mean number of tree per feddan of citrus and apple trees or cantaloupe plants were counted and the mean number of flowers per feddan was calculated.

Table 1. Cultivated area with citrus, apple and cantaloupe in different localities of North Sinai.

Localities	Citrus trees	Areas of Exoerimental Crops (Feddans)*	
		Apple trees	Cantaloupe plants
Bear El-Abd	237 (15.42)	11 (2.86)	397 (8.89)
Al-Arish	169 (10.99)	141 (36.72)	1255 (28.09)
El-Sheikh Zowayed	61 (3.97)	151 (39.32)	1776 (39.75)
Rafah	1070 (69.62)	81 (21.09)	1040 (23.27)
Total	1537	384	4468

* According to the data recorded by Ministry of Agriculture, Al-Arish (2001). Data between brackets represent the percentages.

2. Numbers of citrus, apple and cantaloupe flowers :

In case of citrus orchards, each tree contains three main branches, each has an average number of 251 flowers, with the mean total number of 753 flowers/tree. Taking into consideration the mean number of 160 trees/feddan, the total number of flowers per feddan is about 120480.

In apple orchards, each tree has three main branches, each contains an average number of 1039 flowers, with the mean total number of 3117 flowers/tree. There are an average of 120 trees/feddan, then the total number of flowers per feddan averaged approximately 374040.

For cantaloupe, the mean number of the flowers on each plant was found to be about 30 flowers. Taking into consideration the presence of approximately 4000 plants/feddan, the total mean number of flowers in one feddan cultivated with cantaloupe is about 120000.

Therefore the mean number of flowers having nectar in each tested locality could be calculated for each crop and therefore, the amounts of nectar in each locality could be easily expected. Such nectar amounts may gather by bees during blooming periods of the crops.

3. Volumes and properties of nectar picked up from citrus, apple and cantaloupe flowers :

a. Citrus flowers :

The volumes and properties of nectar taken from the flowers of citrus in North Sinai was determined during the day times of the flowering period. The flowering period for this crop started on February 25 and finished, on April 20. The flowering peak was found during the period from February 20-22, 2001. During this period, seven inspection times during the day, i.e., 10,

11 a.m, 12 noon, 1,2,3 and 4 p.m. were made to obtain the volume of nectar in gathered 100 flowers and the quantity of solid compounds in the nectar and its concentration were determined. Moreover, the daily mean temperature and the relative humidity were recorded. The obtained data are tabulated in Table (2). From this table, it is obvious that the mean volume of citrus nectar varied during the day. The maximum volume was recorded at 11 a.m, 23, noon, 1,2,3 and 4 p.m., being 93.33, 100.00, 80.00, 86.67, 100.00 and 86.67 mm³/100 citrus flowers, with no significant difference between these means. The L.S.D. value emphasize the obtained results. The minimum nectar volume was, however, obtained in the morning; at 10 a.m. (53.33 mm³/100 flowers), which differed significantly from the other means obtained at any day time (Table 2). The same trend could be applied for the amounts of solid compounds in the citrus nectar, being high at late morning (11 a.m.), at noon and from 2 to 4 p.m. (17.10, 19.40, 17.23, 18.63 and 17.23 mg/100 flowers, respectively with no significant difference between them). The low quantity of solid compounds in the nectar was recorded in the morning at 10 a.m. where 10.20 mg/100 flowers were obtained. However, an intermediate amount of these compound (14.20 mg/100 flowers) was obtained just afternoon (at 1 p.m.).

The concentration of the nectar was determined during the day times, ranging between 17.83% at 1 p.m. and 20.17% at 4 p.m. with no significant difference between both means.

Correlation coefficients were calculated. The obtained data show that the correlation between the relative humidity, from one hand and volume and concentration of nectar during the day times, from the other hand, was found to be negative but insignificant, being -0.1249 and -0.4402, respectively. Same trend could be applied for the correlation between mean temperature and concentration of the citrus nectar (-0.1674), but the correlation between temperature and nectar volume during the day time was insignificant positive (0.2831).

Table (2): Volume and properties of nectar picked up from flowers of *Ctirus* in Northern Sinai during the day periods (flowering peaks during March 20-22).

Time of inspection during the day	Volume of nectar in 100 flowers (mm ³)	Quantity of solid compounds in nectar of 100 flowers (mg)	Concentration of nectar (%)	Mean Temperature (°C)	Relative humidity (%)
10 a.m.	53.33	10.20±1.77	19.17	17.3	75
11	93.33	17.10±8.28	18.50	17.4	74.3
12	100.00	19.40±5.09	19.5	18.4	71.3
1 p.m.	80.00	14.20±3.05	17.83	19.0	69.6
2	86.67	17.23±5.10	19.83	19.2	66.3
3	100.00	18.63±5.16	18.67	18.2	68.6
4	86.67	17.23±4.12	20.17	17.4	71.3
Mean ±SE	85.71	16.28	19.09		
F-value	3.35*	4.98	0.99		
L.SD at 0.05	21.00	2.45	-		

b. Apple flowers :

Volumes and properties of nectar taken from the flowers of apple in North Sinai was determined during the day times of the flowering period. The flowering period for this fruit crop started on January 19 and finished on March 5. The blooming peak was found during the period from February 20-22, 2001. During this period seven inspection times during the day, i.e., 10, 11 a.m., 12 at noon, 1, 2, 3 and 4 p.m. were made to obtain the volume of nectar in 100 gathered flowers and the quantity of solid compounds in the nectar and its concentration were determined. Moreover, the daily mean temperature and the relative humidity were recorded. The obtained data are tabulated in Table (3).

Data in table (3), indicated that the mean volume of apple nectar varied during the day. The maximum volume was recorded at 4 p.m. (144 mm³/100 apple flowers), followed by that of flowers picked up either in the morning (at 10 and 11 a.m., being 108.33 mm³/100 flowers in both cases) or after noon (at 2 and 3 p.m., being 116.67 mm³/100 flowers in both cases), and the minimum was, however, obtained at noon and at 1 p.m., when 91.67 mm³/100 flowers were recorded in both cases.

L.S.D. value (13.91) emphasizes the obtained results (Table 3). The same trend could be applied for the amounts of solid compounds in the apple nectar. By applying the L.S.D. value (4.19), the quantity of solid compounds in the apple flowers could be arranged descendingly into the following three groups:

- First group contained flowers picked up at 2,3 and 4 p.m. (26.00, 25.75 and 30.00 mg/100 flowers, respectively).
- Second group included flowers picked up at 10 and 11 a.m. and 2 p.m. (22.91, 23.75 and 26.00 mg/100 flowers, respectively).
- Third group contained flowers taken at 10 and 11 a.m., at noon, and at 1 p.m. (22.91, 23.75, 20.91 and 20.25 mg/100 flowers, respectively).

This means that the highest amount of apple nectar with highest quantity of solid compounds were found in the flowers, visited by honeybee worker at late afternoon.

On the other hand the highest concentration of nectar (23.33%) was recorded at noon and the lowest was, however recorded at late afternoon (at 3 and 4 p.m.). An intermediate concentrations of nectar were recorded at the other times, either in the morning or at early afternoon (Table 3).

Correlation coefficients between the volume and concentration of apple nectar from one hand and the mean temperature and relative humidity during the day times from the other hand were estimated and the obtained results could be summarized as follows : There was a positive and insignificant correlation between the mean temperature and concentration of nectar in the flower (0.2913), while this correlation was negative and significant in case of volume of nectar (-0.2094). The relative humidity affected significantly the volume and concentration of nectar. However this effect was found to be positive in case of volume and negative in case of concentration, where the correlation coefficients were 0.8904 and -0.8285, respectively.

In the available literature, the nectar secretion in 10 cultivars of apple trees ranged from 0.29 to 1.39 mg/flower and the sugar concentration from 33.9 to 49.2% (Szklanowska, 1987). Later on the same author reported that nectar secretion varied from 28.9 mg/10 flowers in Gorgeous apple to only 6.5 mg/10 flowers in John Dowine apple. The average nectar sugar concentration varied from 51.7% in Lady North Cliffe to 33.9% in *M. zumi* var. *calocarpa* (Szklanowska, 1989). According to Abrol (1990), the volume of nectar secreted by flowers of some apple cultivars ranged between 0.05 and 0.68 µl/flower per day. Sugar concentration in nectar was varied from, 20 to 45%, while the weight of sugar secreted per day ranged between 0.0189 and 0.2060 mg/flower.

c) Cantaloupe flowers :

Volume and properties of nectar taken from the flowers of cantaloupe in North Sinai was determined during the day times of the flowering period. The flowering period for this vegetable crop started from February 25 till April 15. The flowering was found to be during the period peak was found during the period from March 25-27, 2001. During this period seven inspection times during the day, i.e., 10, 11 a.m., 12 at noon, 1,2,3 and 4 p.m. were made to obtain the volume of nectar in gathered 100 flowers and the quantity of solid compounds in the nectar and its concentration were determined. Moreover, the daily mean temperature and relative humidity were recorded. The obtained data are tabulated in (Table 4).

Table (3): Volume and properties of nectar picked up from flowers of Apple in Northern Sinai during the day periods (flowering peaks during February 20-22).

Time of inspection during the day	Volume of nectar in 100 flowers (mm ³)	Quantity of solid compounds in nectar of 100 flowers (mg)	Concentration of nectar (%)	Mean Temperature (°C)	Relative humidity (%)
10 a.m.	108.33	22.91±4.20	21	15.6	57.6
11	108.33	23.75±5.55	21.67	16.9	52.3
12	91.67	20.91±6.44	23.33	18.1	52.6
1 p.m.	91.67	20.25±8.22	22.00	18.6	53.3
2	116.67	26.00±5.79	21.33	18.9	55.3
3	116.67	25.75±11.13	20.67	18.4	57.3
4	144.00	30.00±4.08	20.00	17.1	64.6
Mean ±SE	111.0480	24.22	21.429		
F-value	9.55	6.25	7.29		
L.SD at 0.05	13.91	4.19	1.15		

Data in table (4), indicated that the mean volume of cantaloupe nectar varied during the day. The largest volume was recorded from 11 a.m. till the late afternoon (at 4 a.m.) and 1 p.m., and the smallest was, however obtained at 10 a.m. The L.S.D. value (20.95) emphasizes the obtained

results (Table 4). The same trend could be applied for the amounts of solid compounds in the cantaloupe nectar being high at 1 p.m. and low in the morning at 10 a.m. The opposite was, however, true for the concentration of nectar; the highest was at 10 and 11 a.m., which the minimum was during the period extending from 12 noon to 2 p.m. (Table 4).

Table 4. Volume and properties of nectar picked up from flowers of Cantaloupe in Northern Sinai during the day periods (flowering peaks during March 25.27).

Time of inspection during the day	Volume of nectar in 100 flowers (mm ³)	Quantity of solid compounds in nectar of 100 flowers (mg)	Concentration of nectar (%)	Mean Temperature (°C)	Relative humidity (%)
10 a.m.	53.33	23.26±4.01	43.67	17.0	67.3
11	93.33	33.90±7.01	42.33	18.0	65.6
12	100.00	32.30±10.25	40.83	19.1	62.3
1 p.m.	80.00	38.06±3.65	40.83	19.4	61.6
2	86.67	35.60±6.58	39.17	19.8	62.3
3	100	34.46±3.21	41.00	20.1	64
4	86.67	34.50±9.79	42.17	19.4	69
Mean ±SE	85.714	33.15	41.857		
F-value	5.88	9.97	13.24		
L.SD at 0.05	20.95	2.31	1.756		

Positive and significant correlation was noticed between the mean temperature and nectar volume (0.6939), while the correlation between the temperature degrees and nectar concentration was negative and significant (-0.8131). Contradicting correlation was obtained for the relative humidity in relation to the volume and concentration of nectar; negative correlation was found between the humidity percentages during the day and the nectar volume (-0.3760), while positive and significant correlation (0.7759) was obtained between relative humidities and nectar concentrations in cantaloupe flowers.

Generally, almond, peaches, citrus and apple orchards as fruit crops, as well as cantaloupe as vegetable crop are considered as the main crops which are cultivated in North Sinai Governorate. At the same time these crops are rich in nectar; the main source of food for honeybees during the blooming periods. Therefore, it is advisable to increase the number of honeybee colonies in areas cultivated with these crops in North Sinai to obtain honeybee products and to raise the crop yields.

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أشجار الفاكهة ونباتات الخضر كمصادر للرحيق لنحل العسل في شمال سيناء ٢- الموالح والتفاح والكتنالوب محمد نجيب البسيوني كلية العلوم الزراعية البيئية بالعريش - جامعة قناة السويس

في هذه الدراسة تم تقييم تزهر كل من الموالح والتفاح والكتنالوب كمصادر للرحيق لنحل العسل في شمال سيناء لاستكمال دراسة سابقة على اللوز والخوخ وكلها محاصيل فاكهة وخضر أساسية في محافظة شمال سيناء . وقد تم حساب المساحات المزروعة من المحاصيل الثلاثة المذكورة بالفدان ومتوسط عدد الأزهار على الشجرة الواحدة ، ومن ثم على أشجار الفدان . وقد وجد مايتى :

- ١ - بالنسبة لفترة تزهر أشجار الموالح فقد بدأت هذه الفترة في ٢٥ من فبراير وانتهت في ٢٠ أبريل من نفس العام وكانت قمة التزهر خلال الفترة من ٢٠-٢٢ فبراير . كما كان أقصى حجم رحيق في الزهرة وكذلك أعلى كمية مواد صلبة خلال الفترة من الساعة الثانية عشر ظهراً حتى الرابعة من مساء نفس اليوم .
- ٢ - بالنسبة لفترة تزهر أشجار التفاح فقد لوحظ أنها بدأت في ١٩ يناير وانتهت في ٥ مارس وكانت قمة التزهر خلال الفترة من ٢٠ إلى ٢٢ فبراير . وقد وجد أن أعلى حجم رحيق بالزهرة في الساعة الرابعة مساء وتوافق ذلك مع أعلى كمية للمواد الصلبة بالرحيق .
- ٣ - بالنسبة لفترة تزهر نباتات الكتالوب فقد وجد أنها بدأت في ٢٥ فبراير وانتهت في ١٥ أبريل وكانت قمة التزهر خلال الفترة من ٢٥ إلى ٢٧ مارس . وقد وجد أن أعلى حجم للرحيق في الزهرة التي قطفت خلال الفترة من الساعة الحادية عشرة صباحاً حتى الرابعة من مساء نفس اليوم بينما كان أعلى كمية للمواد الصلبة بالرحيق في الساعة الواحدة من بعد الظهر وأقلها في الصباح .