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Activity of Honey Bee Foragersin Nectar and Pollen Collection From Flowers of Plum (*Prunus* sp.) Cultivars

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ABSTRACT

The activity of honey bee foragers in collecting of pollen, nectar or both from flowers of three plum, (*prunus* sp.) cultivars (cvs.) was investigated during the flowering season of two successive years,(2012 &2013) in plum orchard at El-kalubia Governorate, Egypt. In general, Hollywoodplum cultivar was significantly more attractant to bee foragers than Santarosa and Golden Japanese cvs. During two studied seasons. For all studied cultivars, honeybee workers worked on flowers throughout the day time with highest activity at 2 p.m. Highest percentage of pollen gatherers was recorded on flowers of Hollywood cultivar 37.7% & 35.4%, followed by Golden Japanese 29.9% & 28.2% then Santarosa flowers 26.1% & 27.4% during the two seasons, respectively. Activity of pollen collection was concentrated in the early time of day for all cultivars with the highest peak at 11 a.m., (mean of 40.9%), while the lowest value was 20.4%. In the other hand, Golden Japanese flowers were significantly attracted the nectar foragers than Santarosa and Hollywood flowers through the two seasons, (37.3% & 36.4%; 34.8% & 33.1% and 28.0% & 27.6% for the previous plum cultivars, respectively). Nectar gathering activity by honeybee from all plum cultivars was strongly concentrated in the second half of day time with a highest mean percentage (43.0%) at 2 p.m.The collection of both nectar and pollen in the same trip by one forager was also observed on the three studied plum cultivars during the two seasons of study. Santarosa flowers attained the first rank encouraging honeybee workers for gathering the both types of food, (39.3%) followed by (35.6%) for Hollywood and (34.2%) for Golden Japanese, (as a mean of two seasons). The more favorite time for this activity pattern is early morning, (44.3%) or late afternoon, (41.8%) with no significant difference between them as a mean of two successive seasons.

Keywords:plum cultivars, pollinationbehavior of honeybee foragers, pollen gatherers, nectar gatherers.

INTRODUCTION

Pollination is one of the most important factors for the production of many fruits and vegetables(Free, 1993). Honeybees (*Apismellifera* L.) play an important role in the pollination of flowers. Most surveys have shown that honeybees form a high percentage of the insects visiting fruit tree flowers(Thorp, 1979; Klungness*et al*., 1983; Verma and Dulta, 1986 and Free, 1993). Bees gather nectar and pollen from flowers for food for their own use.Major role of honeybees in pollinating tree fruits has long been recognized. Stephen (1958) obtained a positive correlation between the number of bees and amount of fruit set in five pear orchards. Free (1962) found that plum trees near to honeybee colonies were visited by more bees and had a greater set than trees further away. Pollen gathering bees are considered the main pollinators of the plum species because of their activity early in flowering (Langridge and Goodman, 1985).Calzoni and Speranza (1998) indicated that foraging activity from 7 to 8 a.m. was generally very rare. The visits were more numerous from 12 to 1 p.m. and from 4 to 5 p.m. It is a well-known fact that foraging activity increases with increasing temperature and sunlight, and with decreasing relative humidity. Foraging activity of honey bees was highest during the second sampling hour of the day.

Also, in the recent study, El-Dereny(2010) found a positive correlation between the numbers of workers visited flower and fruit set in apple (1.92 bees/ flower) and almond (2.0 bees/ flower) orchards. In the same trend, she found a negative correlation with increasing honey bee visits/ flower and fruit firmness in apple or the percentages of empty nuts and the malformed kernels in almond.The behavior of bees during visiting flowers determines their efficiency as pollinators (Free, 1993). Bees collecting pollen, deliberately scrabble over the anthers pulling them towards its body and frequently biting them. Thus, touch the stamens and stigmas and so may pollinate the flowers (Parker, 1926). Whether or not nectar-gatherers pollinate depends upon where they stand on the flowers. Thus when a nectar-gatherer stands on the anthers and pushes its tongue as well as the front part of its body toward the nectaries it touches the stigmas and stamens and so could pollinate, but when it stands on the petals and pushes itself through the stamens and pistil to reach the nectaries, it does not touch the stigmas and so do not pollinate (Vansell, 1942 and Stephen, 1958).

Therefore, the main objective of the current study is to determine and classify the honeybee foragersthat visitedflowers of certain plum cvs. commonly grown in Egypt, (Golden Japanese, Hollywood and Santarosa) at different periodsof the daythroughout the blossoming season of two successive years, (2012 & 2013).

MATERIALS AND METHODS

The current investigations were carried out in plum orchards (2000 m^2) at El-kalubia Governorate, during the two successive seasons (2012, 2013) on mature trees (20 years old) of Golden Japanese, Hollywood and Santarosa cvs. Trees were planted in a clay loamy soil and were of uniform growth, irrigated by furrow irrigation system and maintained according to the program applied. Trees were spaced at 4X5 m. and planted in rows where the cvs. alternated with each other. The experimental field was well provided with strong beehives as pollination requirements (2-3 hives/

ha) which recommended by Delaplane and Mayer (2000).

The study focused on the behavior of honeybee workers on the flowers of the three cvs.

Foraging activity of honeybee workers

Observations were made by randomly selecting five trees from each cv. and randomly choosing ten flowers (Fig.1) at full pink stage from each tree as a replicate (a total 50 flowers/ cultivar) for each cv during the two successive seasons. As flowers reached full open stage, observations and counts were taken from 8 a.m. to 5 p.m. at 3 hour intervals for all of the trees under investigation throughout the whole blooming period (which extended from 3/3 to 21/4 during 2012 and from 7/3 to 18/4 during 2013). The following activities of honeybee foragers were recorded according to (Abd Al-Fattah, 1995 and El-Dereny, 2010).

a. No. of bees/ flower/ min., (mean of 10 flowers)
b. No. of visited flowers/ bee/ min.,(mean of 10 bees).
c. Percentage of pollen, nectar or both honeybees collectors by classifying 20 foragers for each replicate.

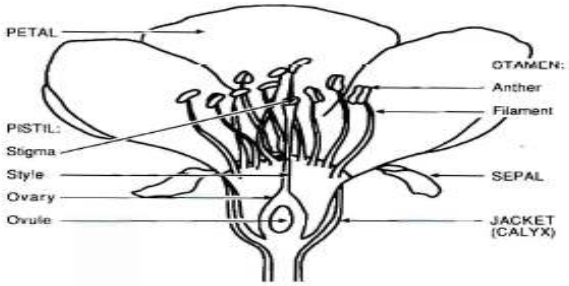

Fig.1. Longitudinal section of a plum flower

Statistical Analyses

Experiments were designed in a randomized complete block design with five replicates; each tree was considered a replicate. Data were subjected to the analysis of variance (ANOVA) according to Freed *et al.* (1989) using MSTAT software and means of treatments were compared using Duncan multiple range test (Version 2.10) at a significance level of 0.05.

RESULTS AND DISCUSSION

1. Foraging activities of honeybee workers

a. Number of bees/ flower/ minute

The mean number of visited bees/ flower/ minutewas significantlydiffered between the three studied cultivars (cvs.)during the day.Highestnumber of bees was found on Hollywood(9.71 bees/ flower/ min.) followed by Santarosa (7.39 bees/ flower/ min.) then Golden Japanese flowers (5.10 bees/ flower/ min.). These means were 9.80 and 9.78;7.48 and 7.40 and 5.07and 5.23 for the mentioned cvs., respectively, during the two successive seasons, 2012 & 2013(Table 1 and Fig. 2).

For the three tested cvs. and during both years of investigation, the foraging activity of bees on plum flowers started in the early morning, and worked until the end of the day (Table 1). There were significant differences between the numbers of foraging bees on plum cvs. throughout the day. Bees started to visit plum flowers from 8 a.m. (5.1 bees/ flower/ min.) and reached their maximum visits at 2 p.m.(10.8 bees/ flower/ min.)after that it declined to 6.7 bees/ flower/ min. at 5 p.m. (Fig. 3).

Results of the present study are in line with the findings of many investigations such as Noro and Yago (1934) and also with Mann and Singh (1983).They agreed that visiting bees to Rosaceae flowers mainly found between 8 a.m. and 5 p.m. also, these findings are in line with data observed by El-Dereny (2010).

b. Number of visited flowers/ bee/ minute

In both two flowering seasons, there were significant differences in foraging activity between the three studied cvs. in terms of the mean numbers of visited flowers/ bee/ minute during the different day time as shown in Table (2). In general, the flowers ofHollywood cv. werevisited in pronounced multi-frequencies of bees (6.15 flowers/ bee/ min.), than other tested plum cvs., (4.72 flowers/ bee/ min.) for Santarosa and (3.3 flowers/ bee/ min.) for Golden Japanese. For Hollywood plum flowers, the number of visited flowers/ bee/ minute was 6.13 and 6.20 flowers/ bee/ minute in 2012 and 2013 seasons. The corresponding respective means for Santarosa cv. were 4.50 and4.99, respectively. On the other hand, the lowest mean number of visited flowers was observed on Golden Japanese cv. (3.11 and 3.59 flowers/ bee/ minute) during the two seasons, respectively. (Table 2and Fig. 4).

Table 1. Mean number of visited bees/ flower/ minute for three different plum varieties during day time during two successive seasons of flowering, (2012 & 2013).

Day Time	2012				2013				Mean/day time ±se
	Golden Japanese	Hollywood	Santarosa	Mean ±se	Golden Japanese	Hollywood	Santarosa	Mean ±se	
8 a.m.	3.3	6.8	5.9	5.3 d ±1.047	2.7	7.8	4.2	4.9 d ±1.518	5.1 D ±0.829
11 a.m.	4.9	10.2	7.4	7.5 b ±1.554	5.7	8.8	6.7	7.1 b ±0.910	7.3 B ±0.812
2 p.m.	8.0	12.6	10.0	10.2 a ±1.339	8.8	14.1	11.1	11.3 a ±1.526	10.8 A ±0.945
5 p.m.	4.1	9.6	6.7	6.8 c ±1.573	3.7	8.4	7.5	6.6 c ±1.435	6.7 C ±0.954
Mean/season ±se	5.07	9.80	7.48	7.4 A ±1.020	5.23	9.78	7.40	7.5 A ±1.371	7.5 ±1.193
Mean/variety ±se		Golden Japanese 5.10 C				Hollywood 9.71 A		Santarosa 7.39 B	

Mean in the same row or column with the same letter (s) are not differed significantly according to Duncan's Multiple Range Test at level 0.05%.

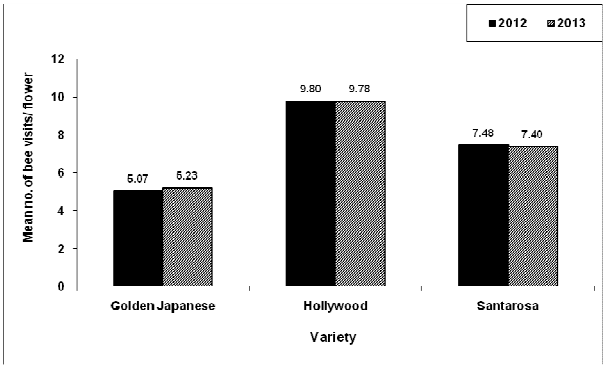

Fig.2. Mean number of bee visits/ flower/ minute for three different plum varieties during day time for two successive seasons of flowering, (2012 & 2013).

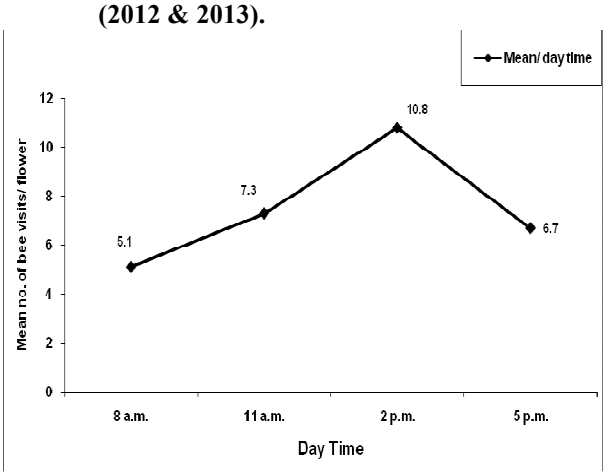

Fig.3. Mean number of bee visits/ flower/ minute for three different plum varieties during day time for two successive seasons of flowering, (2012 & 2013).

As shown in Table (2) and Fig. (5), the number of visited flowers/ bee/ minute for the threetested plumcvs.during the different chronological periods of the dayhad the same trend. During both study seasons,the minimum significant number of flowers was visited at 8 a.m. (3.4 flowers/ bee/ min.). Foraging activity was significantly increased to reach its climax at 2 p.m. with mean value of (6.8), then it declined again by the end of the day (4.1 at 5 p.m.). The general mean number of flowers/ bee/ min. was 4.8 which was less than those recorded by Verma and Dulta (1986) where the average numbers of flowers that honeybees have been seen to visit per minute were 6.6 flowers. These results were also agreed with the earliest observation which recorded by Huston (1926) on apple flowers. Wilson (1926, 1929) and Free (1960) found that adverse weather conditions increased the time spent per flower and bee visitation was differed with different cultivars and from season to another.

c. Pollen and Nectar gathering activity

Data in Tables 3 and 4 clear the foraging activity of honeybee workers on plum flowers for collecting eitherpollen or nectar alone during day time of two successive seasons. But the collection of both pollen and nectar in the same trip by one forager was presented in Table (5). Regarding foraging activity during the different day time, the flowers of the three tested plum cvs.were preferred and attractive to the bee foragers for collecting pollen, nectar or both in the same trip. The early studies by Parker (1926) showed that the honeybees visiting apple, pear, plum and cherry flowers collected either pollen only, nectar only or both.

However, the percentage of pollen gatherers from Hollywood flowers was significantly higher, (37.7% and 35.4%) than nectar gatherers, (28.0% and 27.6%) during 2012 and 2013, respectively. In contrast, the percentage of nectar collectors from Golden Japanese flowers was significantly higher, (37.3% and 36.4%) than pollen collectors, (29.9% and 28.2%) during 2012 and 2013, respectively (Fig. 6 and 7).

Results in Table (5) and Fig. (8)indicatethat a portion of the honeybee workers collected both nectar and pollen together in the same trip from the three tested plum cvs.were nearly at similar rate in 2012 and 2013, (34.3% and37.0%, respectively for Hollywood, 39.1% and 39.5%, for Santarosa and 32.9% and35.4% for Golden Japanese,respectively).

Table 2.Mean number of flowers/ bee/ minute for three different plum varieties during day time during two successive seasons of flowering, (2012 & 2013).

Day Time	2012				2013				Mean/day time ±se
	Golden Japanese	Hollywood	Santarosa	Mean ±se	Golden Japanese	Hollywood	Santarosa	Mean ±se	
8 a.m.	2.3	4.8	3.5	3.5 d ±0.732	2.7	4.0	3.0	3.3 d ±0.406	3.4 D ±0.380
11 a.m.	3.2	6.1	4.3	4.5 b ±0.857	3.9	5.7	5.0	4.8 b ±0.524	4.7 B ±0.455
2 p.m.	4.6	8.2	6.1	6.3 a ±1.066	5.8	9.0	7.2	7.3 a ±0.900	6.8 A ±0.666
5 p.m.	2.5	5.4	4.1	4.0 c ±0.844	2.0	6.2	4.7	4.3 c ±1.227	4.1 C ±0.669
Mean/season ±se	3.11	6.13	4.50	4.6 B ±0.609	3.59	6.20	4.99	4.9 A ±0.871	4.8 ±0.740
Mean/variety ±se	Golden Japanese 3.30 C				Hollywood 6.15 A			Santarosa 4.72 B	

Mean in the same row or column with the same letter (s) are not differed significantly according to Duncan's Multiple Range Test at level 0.05%.

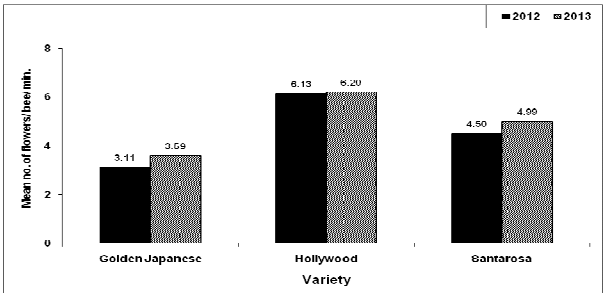

Fig.4. Mean number of flowers/ bee/ minute for three different plum varieties during day time for two successive seasons of flowering, (2012 & 2013).

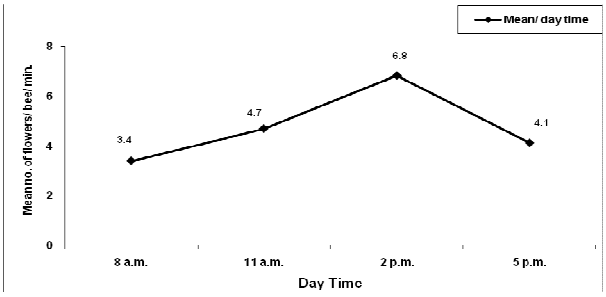

Fig.5. Mean number of flowers/ bee/ minute for three different plum varieties during day time for two successive seasons of flowering, (2012 & 2013).

Table (3 and 4) and Figures (9 and 10).clearlyemphasize that the collection of pollen from the three tested plum cvs. occurred before mid-day with a maximum peak at 11 a.m. By peak time, the percentages of pollen collectors were 51.1% and 48.4% for Hollywood, 32.7% and 37.3% for Santarosa and 36.8% and 39.1% for Golden Japanese trees in 2012 and 2013, respectively.

These findings were coincided with those founded by Vansell (1942), Percival (1955) and Stephen (1958). They agreed that the honeybee foragers increased their activities in collecting pollen only from early morning, (8 a.m.) and reach the gathering peak before midday and then rapidly decreased towards the end of the day.

A reverse behavior was observed for collecting nectar which increased in the middle of day with a peak at 2 p.m. The percentages of nectar collectors were 36.8% and 36.8% for Hollywood, 44.8% and 42.0% for Santarosa and 47.7% and 49.7% for Golden Japanese trees during 2012 and 2013, respectively.

Many authors worked on the behavior of honeybees on stone fruits found that the collection of nectar occurred throughout the day time with a peak in the second half of the day time and correlated with the flower age, (Thorp, 1979 and Klungness*et al.*, 1983), the flower type (Verma and Dulta, 1986) and prevailing conditions, (Williams and Brain, 1985 and El-Dereny, 2010)

Both pollen and nectar were collected from the three tested plum cvs. during early morning (44.3%at 8 a.m.) then this activity was declined gradually at mid-day, after that it rise again during the end of the day (41.8%at 5 p.m.) as shown in Table (5) and Fig. (11).

Table3.Mean percentage of honeybee foragers collected Pollen from three Plum varieties through diurnal hours in two successive seasons, (2012 & 2013).

Season	Day Time	Hollywood	Santarosa	Golden Japanese	Mean ±se
2012	8 a.m.	43.7	30.4	31.7	35.3 b ±4.223
	11 a.m.	51.1	32.7	36.8	40.2 a ±5.568
	2 p.m.	31.8	23.8	28.5	28.0 c ±2.315
	5 p.m.	24.3	17.7	22.4	21.4 d ±1.963
Mean/season ±se		37.7 a ±5.983	26.1 c ±3.392	29.9 bc ±3.028	31.2 A ±4.110
2013	8 a.m.	41.5	27.5	28.8	32.6 b ±4.495
	11 a.m.	48.4	37.3	39.1	41.6 a ±3.421
	2 p.m.	31.4	26.3	25.5	27.8 c ±1.827
	5 p.m.	20.3	18.3	19.5	19.4 d ±0.580
Mean/season ±se		35.4 a ±6.119	27.4 c ±3.895	28.2 b ±4.107	30.3 A ±4.643
Mean/variety ±se		36.6 A ±3.985	26.8 B ±2.402	29.0 B ±2.382	-------
8 a.m.		42.6 b	28.9 b	30.2 b	33.9 B ±4.359
11 a.m.		49.7 a	35.0 a	38.0 a	40.9 A ±4.492
2 p.m.		31.6 c	25.1 c	27.0 c	27.9 C ±1.928
5 p.m.		22.3 d	18.0 d	20.9 d	20.4 D ±1.269

Mean in the same row or column with the same letter (s) are not differed significantly according to Duncan's Multiple Range Test at level 0.05%.

Table 4.Mean percentage of honeybee foragers collected Nectar from three Plum varieties through diurnal hours in two successive seasons, (2012 & 2013).

Season	Day Time	Hollywood	Santarosa	Golden Japanese	Mean ±se
2012	8 a.m.	18.5	24.4	26.0	23.0 d ±2.280
	11 a.m.	25.5	29.8	32.9	29.4 c ±2.158
	2 p.m.	36.8	44.8	47.7	43.1 a ±3.251
	5 p.m.	31.2	40.4	42.7	38.1 b ±3.507
Mean/season ±se		28.0 b ±3.924	34.8 a ±4.681	37.3 a ±4.869	33.4 A ±4.480
2013	8 a.m.	16.2	21.0	24.4	20.5 d ±2.368
	11 a.m.	24.2	31.0	30.6	28.6 c ±2.197
	2 p.m.	36.8	42.0	49.7	42.8 a ±3.762
	5 p.m.	33.3	38.6	40.7	37.5 b ±2.192
Mean/season ±se		27.6b ±4.636	33.1 a ±4.673	36.4 a ±5.580	32.4 A ±4.925
Mean/variety ±se		27.8 B ±2.812	34.0 A ±3.079	36.8 A ±3.433	-------
8 a.m.		17.4 d	22.7 d	25.2 d	21.7 D ±2.309
11 a.m.		24.8 c	30.4 c	31.8 c	29.0 C ±2.117
2 p.m.		36.8 a	43.4 a	48.7 a	43.0A ±3.449
5 p.m.		32.3 b	39.5 b	41.7 b	37.8 B ±2.847

Mean in the same row or column with the same letter (s) are not differed significantly according to Duncan's Multiple Range Test at level 0.05%.

Table 5. Mean percentage of honeybee foragers collected both Pollen and Nectar from three Plum varieties through diurnal hours in two successive seasons, (2012 & 2013).

Season	Day Time	Hollywood	Santarosa	Golden Japanese	Mean ±se
2012	8 a.m.	37.80	45.18	42.26	41.7 a ±2.146
	11 a.m.	23.45	37.50	30.60	30.5 b ±4.055
	2 p.m.	31.37	31.90	23.75	29.0 b ±2.634
	5 p.m.	44.52	41.96	34.94	40.5 a ±2.865
Mean/season ±se		34.3 bc ±4.500	39.1 a ±2.879	32.9 c ±3.882	35.4 A ±3.301
2013	8 a.m.	42.25	51.58	46.88	46.9 a ±2.694
	11 a.m.	27.42	31.71	30.25	29.8 b ±1.260
	2 p.m.	31.88	31.63	24.75	29.4 b ±2.334
	5 p.m	46.33	43.08	39.79	43.1 a ±1.888
Mean/season ±se		37.0 bc ±4.404	39.5 ab ±4.844	35.4 c ±4.924	37.3 A ±4.509
Mean/variety ±se		35.6 B ±2.959	39.3 A ± 2.609	34.2 B ±2.942	-------
8 a.m.		40.0 b	48.4 a	44.6 a	44.3 A ±2.416
11 a.m.		25.4 d	34.6 c	30.4 c	30.2 B ±2.650
2 p.m.		31.6 c	31.8 d	24.3 d	29.2 B ± 2.481
5 p.m.		45.4 a	42.5 b	37.4 b	41.8 A ±2.358

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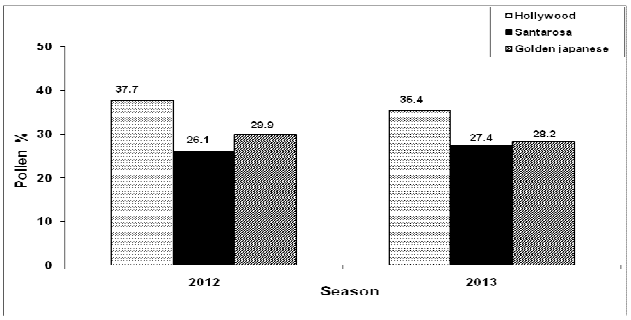

Fig. 6. Mean percentage of honeybee foragers collected Pollen from three Plum varieties through diurnal hours in two successive seasons, (2012 & 2013).

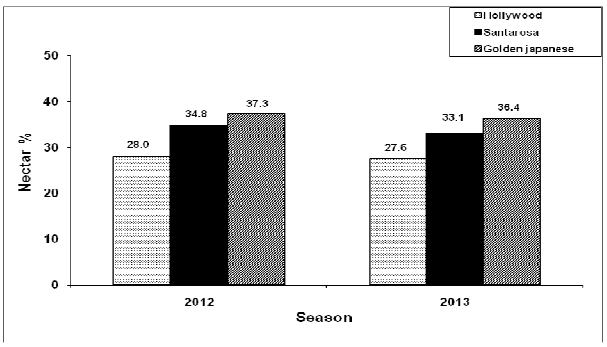

Fig. 7. Mean percentage of honeybee foragers collected Nectar from three Plum varieties through diurnal hours in two successive seasons, (2012 & 2013).

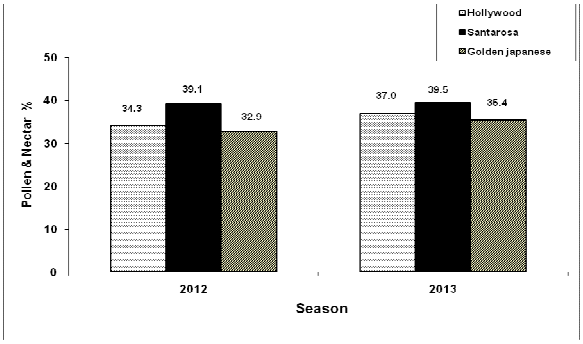

Fig. 8. Mean percentage of honeybee foragers collected both Pollen and Nectar from three Plum varieties through diurnal hours in two successive seasons, (2012 & 2013).

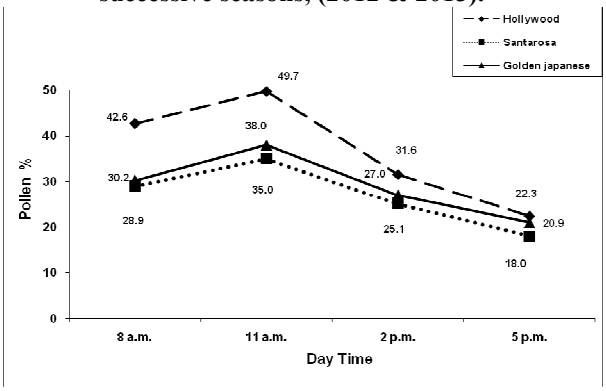

Fig9. Mean percentage of honeybee foragers collected Pollen from three Plum varieties through diurnal hours in two successive seasons, (2012 & 2013).

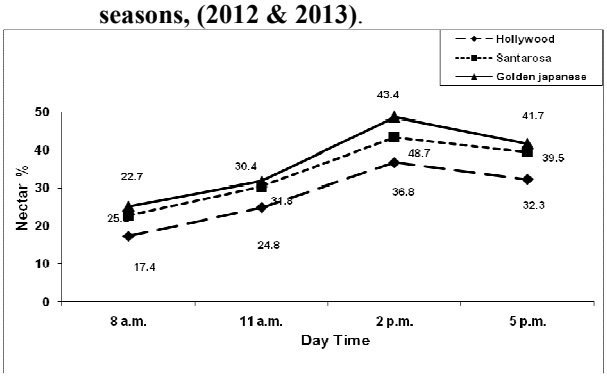

Fig 10. Mean percentage of honeybee foragers collected Nectar from three Plum varieties through diurnal hours in two successive seasons, (2012 & 2013).

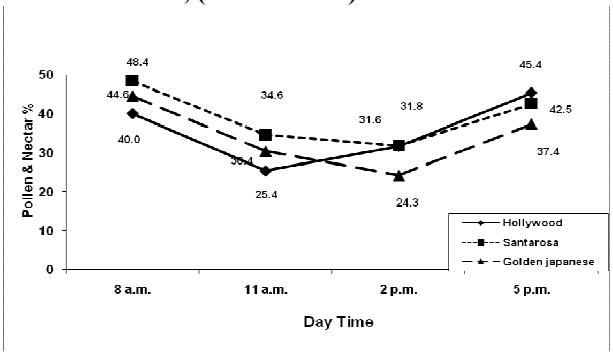

Fig 11. Mean percentage of honeybee foragers collected both Pollen and Nectar from three Plum varieties through diurnal hours in two successive seasons, (2012 & 2013).

REFERENCES

Abd Al-Fattah, M.A. (1995). The behaviour of honeybee (*Apis mellifera* L.) workers on two cultivars of sesame crop, (*Sesamum indicum* L.) and their relative role in the pollination. Bull. Ent. Soc. Egypt, 73: 143-158.

Calzoni, G. L. and Speranza, A. (1998). Insect controlled pollination in Japanese plum (*Prunus saliciana* Lindl.). ScientiaHorti., 72(3-4):227-237.

Delaplane, K.S. and Mayer, D.F.(2000).Crop pollination by bees.CABI publishing,NewYork;pp.1-7;139-153.

Duncan, D. B. (1955). Multiple range and multiple F-test. Biometrics, 11: 1-24.

El-Dereny, Sarah, H. (2010). Studies on cross pollination of apple and almond trees (Family: Rosaceae) by honeybee foragers (*Apis mellifera* L.). M.Sc. Thesis, Fac. Agric., Cairo Univ.

Free, J.B. (1960). The behavior of honeybees visiting flowers of fruit trees. J. Anim. Ecol., 29:385-395.

Free, J.B. (1962). The effect of distance from the pollinator varieties on the fruit set on trees in plum and apple orchards. J. Hort. Sci., 37(4):262-271.

Free, J.B. (1993). Insect Pollination of Crops.Second Edition, Academic Press, London; pp.431-466.

Freed, R.; Eienensmith, S. P.; Gutez, S.; Reicosky, D.; Smail, V. W. and Woldberg, P. (1989). User's Guide to MSTAT-C Analysis of Agronomic Research Experiments. Michigan state university, East Lansing, USA.

Huston, R. (1926). Relation of the honeybee to fruit pollination in New Jersey. Bull. N.J. Agric. Exp. Stn., No. 434.

Klungness, M.; Thorp, R. and Briggs, D. (1983). Field testing germinability of almond pollen (*Prunus dulcis*). J. Hort. Sci., 58:229-235.

Langridge, D. F. and Goodman, R. D. (1985).Honeybee pollination of Japanese plums (*Prunus salicina* Lindl. cv. Satsuma) in the Goulburn Valley, Victoria. Aust. J. of Exp. Agric., 25 (1): 227 – 230.

Mann, G. S. and Singh, G. (1983).Activity and abundance of pollinators of plum at Ludhiana (Punjab). Am. Bee J., 123(8):595.

Noro, K. and Yago, M. (1934).Studies on sterility of the Japanese pear Chojuro with special reference to hand pollination, dehiscence of anthers and insect visitors.Bull.ShizuokakenAgric.Exp.Stn.,No.29, 13.

Parker, R.L. (1926).The collection and utilization of pollen by the honeybee.Mem. Cornell. Agric. Exp. Stn., No. 98.

Percival, M.S. (1955). The presentation of pollen in certain angiosperms and its collection by *Apis mellifera*. New Phytol, 54:353-368.

Stephen, W.P. (1958). Pear pollination studies in Oregon. Bull. Ore. Agric. Exp. Stn., No. 43.

Thorp, R. (1979). Honey bee foraging behavior in California almond orchard. Proceedings of 4th International Symposium on Pollination, Maryland Agricultural Experimental Station, 1:385-392.

Vansell, G.H. (1942). Factors affecting the usefulness of honeybees in pollination. U.S. Dep. Agric. Circ., No. 650.

Verma, L.R. and Dulta, P.C. (1986).Foraging behavior of *Apisceranaindica* and *Apis mellifera* in pollinating apple flowers. J. Apic. Res., 25:197-201.

Williams, R.R. and Brain, P. (1985).Honeybee activity when visiting flowers of the apple cultivars Cox's Orange Pippin and Golden Delicious. J. Hort. Sci., 60:25-28.

Wilson, G.F. (1926). Insect visitors to fruit blossoms. J. R. Hort. Soc., 51:225-251.

Wilson, G.F. (1929). Pollination of hardy fruits: insect visitors to fruit blossoms. Ann. Appl. Biol., 16:602-629.

نشاط شغالات نحل العسل السارحة فى جمع الرحيق وحبوب اللقاح من ازهار اصناف البرقوق (*prunus* sp.)

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أجريت هذه الدراسة على أشجار برقوق عمر ٢٠ سنة لأصناف Golden Japanese، Hollywood وSantarosa نامية فى مزرعة خاصة بمحافظة القليوبية خلال موسمى ٢٠١٢ و٢٠١٣. استهدفت الدراسة سلوك ونشاط شغالات نحل العسل لأزهار أصناف البرقوق المذكورة وأوضحت النتائج الأتى:كان صنف Hollywood أكثر جذباً لشغالات نحل العسل (٩,٨٠ و٩,٧٨) تلاه صنف Santarosa (٧,٤٨ و ٧,٤٠) ثم صنف Golden Japanese (٥,٠٧ و ٥,٢٣) وذلك لموسمى الدراسة ٢٠١٢ و ٢٠١٣، على التوالى.ولذلك فقد إرتفع متوسط عدد الأزهار/ النحلة/ الدقيقة على صنف Hollywood حيث كانت (٦,١٣ و٦,٢٠) وذلك مقارنة بصنف Santarosa (٤,٥٠ و ٤,٩٩)وصنف Golden Japanese (٣,١١ و ٣,٥٩) خلال موسمى الدراسة على التوالى. يظهر نشاط سروح النحل على ازهار البرقوق مبكراً ثم يصل النشاط إلى ذروته بعد الظهر ثم يبدا فى الإنحسار تدريجياً بعد ذلك وذلك خلال موسمى الدراسة. فى كلا موسمى الدراسة، كانت نسبة جامعات حبوب اللقاح على صنف Hollywood هى الأعلى (٣٧,٧٪ و٣٥,٤٪) وذلك مقارنة بصنف Golden Japanese (٢٩,٩٪ و٢٨,٢٪) وصنف Santarosa (٢٦,١٪ و٢٧,٤٪) على التوالى. تركز نشاط جمع حبوب اللقاح من الأصناف الثلاثة قبل منتصف النهار وتم تسجيل ذروته عند الساعة ١١ صباحاً (٤٠,٩٪). على النقيض من ذلك، تم ملاحظة نشاط جمع الرحيق والذى زاد فى فترة بعد الظهر وذروته كانت فى الساعة ٢ منتصف النهار (٤٣,٠٪) فى كلا موسمى الدراسة، وكانت نسبة جامعات الرحيق من صنف Golden Japanese هى الأعلى (٣٧,٣٪ و٣٦,٤٪) وذلك مقارنة بصنف Santarosa (٣٤,٨٪ و٣٣,١٪)وصنف Hollywood (٢٨,٠٪ و٢٧,٦٪) على التوالى.كانت نسبة الشغالات التى تعمل على جمع كلا من الرحيق وحبوب اللقاح معاً فى نفس الرحلة الواحدة متماثلة بدون فروق معنوية للمتوسطات للثلاثة أصناف Hollywood (٣٥,٦٪)، Santarosa (٣٩,٣٪) وGolden Japanese (٣٤,٢٪). يستخلص مما سبق أن أصناف البرقوق الثلاثة تعتبر مصدراً جيداً للرحيق وحبوب اللقاح لطوائف نحل العسل فى بداية فصل الربيع حيث تجذب أزهارها شغالات النحل طوال ساعات النهار ولفترة تصل إلى أكثر من شهر تقريباً.

الكلمات الدالة: اصناف البرقوق، نشاط سلوك التلقيح لسارحات نحل العسل، جامعات حبوب اللقاح، جامعات الرحيق.