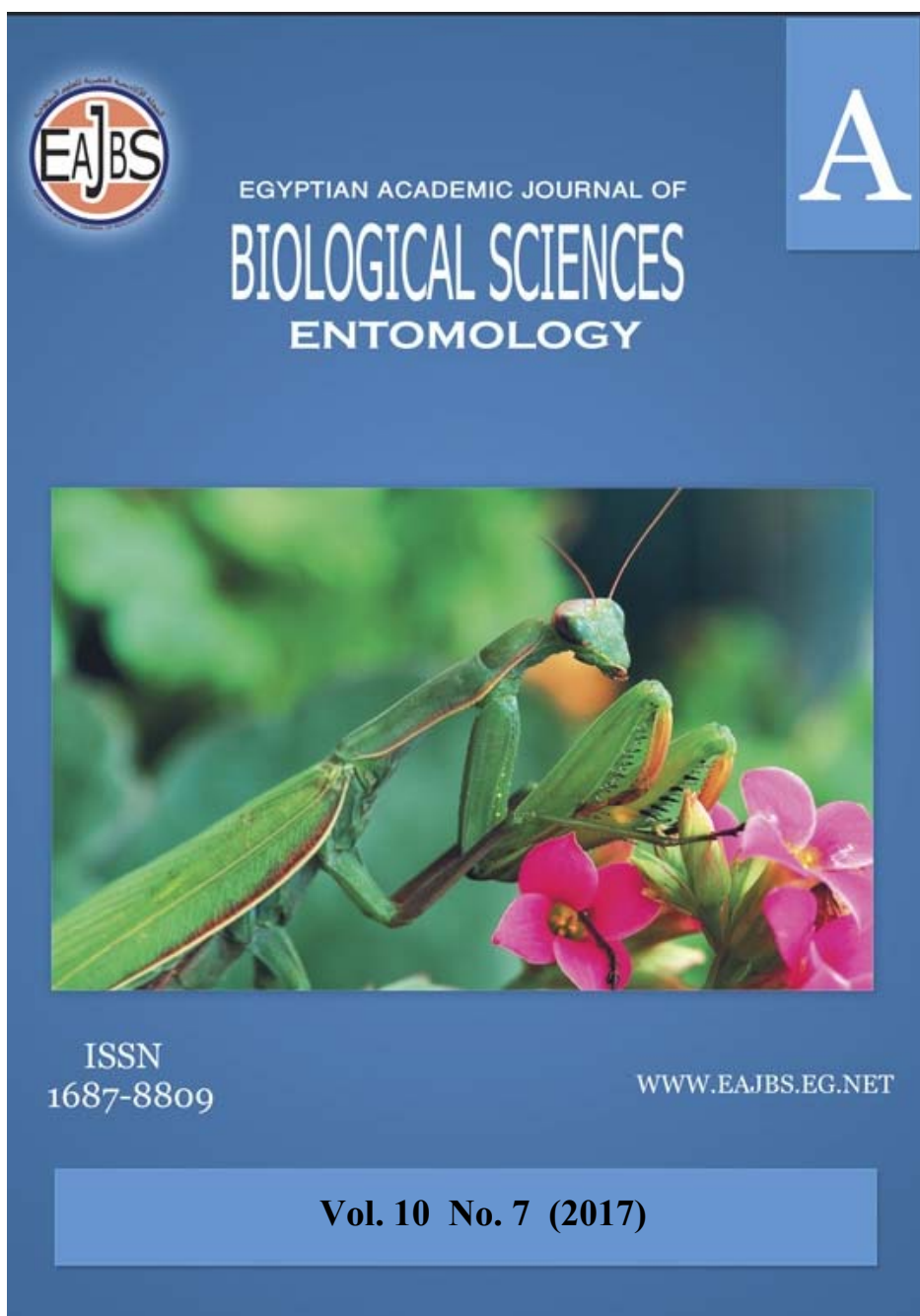


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**Relationship Between Honeybee Workers and Plum Orchards
II. Its Role as A pollinator in Fruit Set and Quality**

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ABSTRACT

The present study was carried out on three plum cultivars; Golden Japanese, Hollywood and Santarosa during two successive seasons 2012 and 2013 to study the influence of different pollination treatments on fruit set and fruit characteristics of the studied cultivars.

Several sequential treatments were applied from 1 bee worker visit/ flower up to ten bee visits/ flower besides zero visit (self-pollination/ control) and open pollination treatments. The relationship between the foraging activity of honeybees in cross-pollinated flowers of plum cultivars and both fruit set and the main fruit characteristics were investigated. Bee foragers expressed significant benefit to plum cultivars on final fruit set as well as on fruit characteristics; fruit weight, fruit volume and Total Soluble Solids (T.S.S. %) improved fruit quality through decreasing fruit firmness.

Results of the present study showed direct improvements as a result of increased bee visits/ flower which were reflected on significant increase in fruit set when comparing self-pollination with open pollination. Results were 18.7%, 86.7%; 27.5%, 95.7%; 28.6%, 91.3% for season 2012 and 19.7%, 87.5; 26.9%, 96.0%; 26.1%, 94.7% for season 2013, for the three studied cvs., respectively.

Moreover, fruit characteristics showed positive effects of increasing bee visits/ flower were expressed as significant improving in fruit weight which increased by 3.02, 2.26 and 2.13 folds for Golden Japanese, Hollywood and Santarosa cultivars, respectively.

Consequently, significant improvements in final fruit set, fruit volume, T.S.S. % and firmness were recorded and presented. Thus, it can be recommended from results of the present study to maintain sufficient honey bee colonies in plum orchards that offer at least ten bee visits/ flower to increase fruit set and to achieve satisfactory improvement in yield and fruit characteristics.

INTRODUCTION

Plum belongs to the Rosaceae family; most commercial plum varieties grown in Egypt are either totally or partially self-unfruitful and require cross-pollination to produce commercial crops. Unsatisfactory crop yield from Plum has been traced to insufficient or ineffective pollination.

It is important to ensure that suitable varieties with similar blossoming periods are planted throughout the orchard to ensure that there is adequate pollen variation for cross pollination (Abdelaziz, *et al.*, 2005 and Hassan *et al.*, 2007).

Pollen grains of many stone fruit species is too heavy to be carried by wind in sufficient quantities to produce a good set. Thus, insects foraging in flowers for pollen (their protein source) and nectar (their calorie source) must be relied on to carry most of the pollen. Honeybees (*Apis mellifera*) are the most important pollinators for plums (Free, 1993; Calzoni and Speranza, 1996; 1998; Delaplane and Mayer, 2000 and Guerra and Rodrigo, 2015) and several studies have demonstrated an apparent relationship between the number of honeybees and the fruit quality of crop which are particularly important characteristics when fruits are to be consumed fresh (Stern *et al.*, 2001; Hassan *et al.*, 2007 and Guerra, 2010).

The duration of flowering of a specific tree can vary from one week to several weeks. To set satisfactory commercial crops on plum varieties needing pollinators, varieties must bloom at the same time, be cross compatible, and provide adequate pollen capable of setting fruit (Guerra and Rodrigo, 2015).

The objective of this study was to evaluate the effect of different pollination treatments on productivity and fruit quality of three plum cultivars that are the most commonly grown in Egypt.

MATERIALS AND METHODS

The current investigations were carried out in plum orchards at El-Qalubia Governorate, during the two successive seasons 2012, 2013 on mature trees (20 years old) of Golden Japanese, Hollywood and Santarosacvs. Trees were planted in a clay loamy soil and were of uniform growth. Trees were spaced at 4X5 m. and planted in rows where the cvs. alternated with each other. The study focused on the effect of visiting numbers with honeybee workers on fruit characteristics.

Pollination treatments on plum cultivars flowers.

This point was adopted by selecting five trees from each cv. and each tree was considered a replicate. Twelve pollination treatments were carried out on flowers and each treatment was conducted by selecting forty clusters in each cvs. which were distributed uniformly on different parts of each of the five replicate trees.

The flowers of each cluster were eliminated to the king flower after removing the other lateral flowers (thinning). The selected flowers were bagged and labeled at full pink stage. Flowers were covered with pergamin pollination bags; which allow flowers to receive sunlight and prevent any outside pollinators. Another group of flowers were left uncovered and served as open pollination treatment, which received pollen from all available pollen vectors.

At full bloom, pergamin bags were temporarily removed from each selected group of flowers on the replicate trees one by one and subjected to the following pollination treatments through honeybee visits as follows:

a. Zero bee worker visits/ flower (self-pollination treatment): selected flowers at full pink stage were enclosed in pergamin bags to prevent pollen transfer from another flower. Bags were removed when stigmas became completely dry.

- | | |
|---------------------------------|------------------------------------|
| b. 1 bee worker visit/ flower. | h. 7 bee worker visits/ flower. |
| c. 2 bee worker visits/ flower. | i. 8 bee worker visits/ flower. |
| d. 3 bee worker visits/ flower. | j. 9 bee worker visits/ flower. |
| e. 4 bee worker visits/ flower. | k. 10 bee worker visits/ flower. |
| f. 5 bee worker visits/ flower. | l. Open bee worker visits/ flower. |
| g. 6 bee worker visits/ flower | |

After the required number of bee visits occurred, bags were replaced immediately to prevent contamination by any extra unrequired pollen. Pergamin bags were removed when stigma dried and petals fell.

Measured parameters:

Percentage of fruit set:

The percentage of final fruit set was determined in plum cvs. for all previously mentioned pollination treatments by applying the following formula:

$$\text{Fruit set\%} = (\text{number of fruits/ number of flowers}) \times 100$$

Fruit characteristics:

At harvest, fruits resulting from the different pollination treatments were collected at maturity. The influence of each pollination treatment on Golden Japanese,

Hollywood and Santarosacvs. fruit characteristics was determined by measuring the following parameters:

a. Fruit weight (g.). b. Fruit volume (cm.³).

1- Total Soluble Solids in fruit juice (T.S.S. %) using a hand refractometer according to (AOAC, 1985).

2- Fruit firmness (using a pressure tester, lb/ inch²).

Statistical Analyses:

Experiments were designed in a randomized complete block design with five replicates; each tree was considered a replicate. Data were subject 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 (1955) at a significance level of 0.05.

RESULTS AND DISCUSSION

Final fruit set%:

Table (1) shows that the values of Fruit set percentages of three plum cultivars Golden Japanese, Hollywood and Santarosa under different numbers of pollination treatments during 2012 and 2013 seasons. The data reveal that fruit set percentage for Golden Japanese was positively correlated with the number of honeybee visits being 23.8 and 25.5% for 2012 and 2013, respectively, as a result of one bee visit/flower and significantly increased to 83.3 and 85.7% for 2012 and 2013, respectively, when the number of visits increased to 10 bees/ flower. Similarly, the similar trend of increase was observed for Hollywood and Santarosacvs. At the maximum rate of increment (10 visits/ flower), the percentage of fruit set was significantly improved to 89.5, 88.2% and 88.9, 85%, respectively.

Under open pollination conditions Hollywood gave the highest fruit set, (95.7 and 96%, for 2012 and 2013 respectively). It is evident that self-pollination (Zero bees/ flower) gave the lowest fruit set percentage in all cultivars than all other treatments.

Results of the current investigation agree with the findings of (Langridge and Goodman 1985; Sapir *et al.*, 2007; Stern *et al.*, 2007; Guerra *et al.*, 2010 and Guerra and Rodrigo, 2015) which indicated that increased bee activity in plum orchards leads to high yield and fruit set. El-Dereny, Sarah (2010) showed the similar effect with apple and almond fruits.

A clear improvement was observed in the percentage of final fruit set in the three plum cultivars when flowers received 10 bee visits/ flower. The mean set percentage for Golden Japanese increased to 3.41 folds, Hollywood to 2.27, while for

Santaros ait increased to 2.18 folds, compared to the self-pollinated flowers. Thus emphasizing that cross pollination was more effective in improving the fruit set of Golden Japanese cv. compared to Hollywood and Santarosa.

Table 1: Effect of number of bee visits/ flower on final fruit set (%) of three Plum varieties during two successive seasons, (2012-2013).

No. of bees/ Flower	Golden Japanese (%)		Hollywood (%)		Santarosa (%)		Mean (%) / No. of bees
	2012	2013	2012	2013	2012	2013	
Zero	18.7	19.7	27.5	26.9	28.6	26.1	24.57
1	23.8	25.5	33.3	31.6	31.1	32.7	29.66
2	32.6	30.8	38.2	40.0	37.9	38.5	36.33
3	37.5	36.1	48.0	47.8	45.0	46.4	43.48
4	40.9	39.5	53.6	51.6	52.6	54.5	48.80
5	47.1	44.8	60.0	63.0	60.6	63.2	56.44
6	51.9	56.7	68.2	69.6	61.5	64.0	61.97
7	60.0	63.6	77.3	78.9	66.7	65.0	68.59
8	66.7	68.8	80.0	79.2	70.6	73.3	73.08
9	76.2	75.0	84.2	85.0	76.5	81.8	79.78
10	83.3	85.7	89.5	88.2	88.9	85.0	86.77
Open Pollination	86.7	87.5	95.7	96.0	91.3	94.7	91.98
Mean (%)	52.1	63.0	63.0	59.3	59.3	58.1	58.45

Fruit weight (g.):

Mean fruit weight of plum cvs. were significantly affected by the number of bee visits/ flower during both seasons of study (Table 2). In 2012, the lowest significant mean of fruit weight was 19.93 g. at zero bee visits/ flower but as the number of bee visits increased, there was a significant increment in the mean of fruit weight. Single bee visit/ flower caused a significant increase of 24.90 g. in fruit weight for Golden Japanese cv. and the highest significant fruit weight 80.85 g. was recorded at 10 bee visits/ flower being insignificantly different from the flowers exposed to open pollination (mean fruit weight 84.00 g.).

Table 2: Effect of number of bee visits/ flower on fruit weight (g.) of three Plum varieties during two successive seasons, (2012-2013).

No. of bees/ Flower	Golden Japanese		Hollywood		Santarosa		Mean/No. of bees
	2012	2013	2012	2013	2012	2013	
Zero	19.93	20.97	27.10	26.05	28.16	25.78	24.67 ±1.382 L
1	24.90	26.04	33.54	31.56	31.07	32.61	29.95 ±1.382 K
2	32.62	30.86	37.99	39.37	36.80	38.18	35.97 ±1.397 J
3	35.90	34.81	49.05	48.48	43.49	46.82	43.09 ±2.575 I
4	41.75	40.86	55.63	53.49	54.28	56.82	50.47 ±2.938 H
5	48.24	45.41	60.79	62.96	61.10	64.00	57.08 ±3.300 G
6	53.46	57.32	68.15	70.85	64.65	65.82	63.38 ±2.716 F
7	61.63	64.11	76.92	77.99	69.79	67.34	69.63 ±2.726 E
8	67.26	68.99	80.23	79.87	76.77	74.42	74.59 ±2.232 D
9	76.29	75.53	82.96	83.80	76.75	79.10	79.07 ±1.451 C
10	80.85	83.77	87.07	85.97	86.14	82.54	84.39 ±0.985 B
Open Pollination	84.00	85.29	95.75	97.60	89.97	93.79	91.07 ±2.284 A
Mean ±SE	52.234 ±6.331f	52.830 ±6.555e	62.932 ±6.515b	63.164 ±6.709 a	59.914 ±6.128d	60.600 ±6.094 c	58.61

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

A similar trend was observed in 2013 for plum cvs. as fruit weight significantly increased with increasing the number of bee visits/ flower.

In conclusion, there was a positive significant correlation between the activity of bees and fruit weight. In both seasons of investigation, fruit weight improved by 3.02 folds for Golden Japanese cv., 2.26 folds for Hollywoodcv. and 2.13 folds for Santarosacvs. When flowers were visited by bees 10 times compared to the flowers isolated from cross pollination.

Fruit volume (cm.³):

Fruit volume for the three tested plum cvs. showed a lighter volume for isolated flowers during 2012 and 2013. In 2012, the lowest mean significant fruit volume was 12.08 cm.³ at zero bee visits/ flower for Golden Japanese and jumped to 79.58 cm.³ at 10 bee visits/ flower. In 2013, such result was confirmed and fruit volume increased with the increase in the number of visits by bees. Meanwhile, open pollination differed significantly from 10 bee visits/ flower where the mean reached 86.77 cm.³ and 87.40 cm.³ in 2012 and 2013 seasons, respectively.

During both seasons of investigation fruit volume continuously increased with the increase of the number of bee visits. For the three plum cultivars; Golden Japanese, Hollywood and Santarosa, the means of fruit volume increased by 5.42, 4.23 and 3.90 folds, respectively as a result of increasing the number of bee visits/ flower from zero to 10.(Table 3).

Table 3: Effect of number of bee visits/ flower on fruit volume (cm.³) of three Plum varieties during two successive seasons, (2012-2013).

No. of bees/ Flower	Golden Japanese		Hollywood		Santarosa		Mean/No. of bees
	2012	2013	2012	2013	2012	2013	
Zero	12.08	13.44	17.29	17.08	18.56	16.25	15.78 ±1.019 L
1	18.02	20.31	26.04	22.50	22.40	25.00	22.38 ±1.205 K
2	27.71	26.25	32.71	35.83	32.08	32.92	31.25 ±1.462 J
3	32.50	31.25	42.09	41.25	38.44	39.48	37.50 ±1.861 I
4	37.44	34.69	46.25	41.88	44.25	49.38	42.31 ±2.245 H
5	47.19	44.58	49.94	53.69	51.00	54.58	50.16 ±1.557 G
6	50.10	53.25	62.92	64.06	56.56	59.06	57.66 ±2.224 F
7	57.08	58.65	67.94	71.25	63.54	62.08	63.42 ±2.210 E
8	63.75	66.67	75.25	74.19	68.75	71.67	70.05 ±1.822 D
9	71.56	69.06	79.38	80.63	72.71	77.38	75.12 ±1.903 C
10	79.58	84.17	92.19	87.50	88.75	81.88	85.68 ±1.906 B
Open Pollination	86.77	87.40	97.33	100.00	92.17	93.88	92.92 ±2.156 A
Mean ±SE	48.649 ±6.930 e	49.142 ±7.114d	57.443 ±7.469 a	57.488 ±7.589a	54.101 ±6.969c	55.296 ±6.875 b	53.69

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

It is evident from Table (2) and (3) that the three cultivars under open pollination gave the heaviest and largest fruits followed by 10 bee visits, during the two successive seasons.

Previous results of fruit weight and volume agree with those presented by Abdelaziz *et al.* (1999) who reported statistical differences in fruit weight as a result of different pollination treatments on apple. Also, these results are agreement with those obtained by Hassan *et al.* (2007) on plum and Stino *et al.* (2001) and Yehia *et al.* (2008) on apple and El-Dereny, Sarah (2010) on apple and almond fruits where the biggest fruit size was obtained with open pollination.

Fruit T.S.S. %:

Data in Table (4) indicated that the three cultivars which exposed to open pollination treatment recorded the significantly highest total sugar values. Meanwhile, the three cultivars recorded the lowest total sugars under self-pollination (Zero bee visits) treatment.

The number of bee visits/ flower significantly affected T.S.S. content of plum cvs. during both years of study. In 2012, the lowest T.S.S. was recorded in fruits formed from self-pollinated flowers which were significantly different from those formed from flowers exposed to a single bee visit/ flower, 1.02 and 1.27%, respectively, for Golden Japanese cv., 1.20 and 1.93%, respectively, for Hollywood cv., 1.25 and 1.51%, respectively, for Santarosa cv. Increase the number of bee visits/ flower reached maximum levels at 10 bee visits/ flower and at open pollination 13.18 and 15.29%, respectively, for Golden Japanese cv., 14.77 and 16.11%, respectively, for Hollywood cv., 14.35 and 15.64%, respectively, for Santarosa cv. Same trend was observed in the second season of investigation.

Similar results were reported by Hassan *et al.* (2007) on plum where T.S.S. was affected with different pollination treatments and seem to agree with the findings of (Arafat *et al.*, 1994; Abdelaziz *et al.*, 1999; Stino *et al.*, 2001; Yehia *et al.*, 2008 and El-Dereny, Sarah, 2010) on apple.

The mean T.S.S. throughout both seasons shows that T.S.S. % is associated with the increase of the number of bee visits/ flower. Increasing bee visits/ flower to 10 revealed an increase in T.S.S. in plum cvs. during both seasons of study by 11.95 folds for Golden Japanese, 11.42 for Hollywood and 10.83 folds for Santarosa, compared to the same values for self-pollinated flowers.

Table 4: Effect of number of bee visits/ flower on fruit T.S.S. (%) of three Plum varieties during two successive seasons, (2012-2013).

No. of bees/ Flower	Golden Japanese		Hollywood		Santarosa		Mean/No. of bees
	2012	2013	2012	2013	2012	2013	
Zero	1.02	1.07	1.20	1.13	1.25	1.11	1.13 ±0.035 L
1	1.27	1.32	1.93	1.65	1.51	1.75	1.57 ±0.104 K
2	2.25	2.12	2.51	2.77	2.37	2.60	2.44 ±0.097 J
3	3.16	3.06	3.87	3.76	3.34	3.42	3.43 ±0.132 I
4	4.45	4.17	5.18	4.86	4.73	5.56	4.82 ±0.204 H
5	6.09	5.85	6.31	6.87	6.51	7.08	6.45 ±0.191 G
6	7.43	7.74	8.37	8.58	7.97	8.14	8.04 ±0.171 F
7	8.89	9.10	9.71	9.88	9.44	9.25	9.38 ±0.152 E
8	10.07	10.16	11.27	11.00	10.40	10.63	10.59 ±0.193 D
9	11.71	11.50	12.58	12.81	12.03	12.29	12.15 ±0.207 C
10	13.18	13.79	14.77	14.16	14.35	13.49	13.96 ±0.238 B
Open Pollination	15.29	15.42	16.11	16.21	15.64	15.89	15.76 ±0.153 A
Mean ±SE	7.064 ± 1.391	7.108 ±1.426 d	7.817±1.47	7.805 1.469 a	7.460 ±1.439 c	7.601 ±1.406 b	7.48

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

Fruit firmness (lb/inch²):

Table (5) revealed that, a highly significant negative relation was existed between fruit firmness and the number of bee visits and generally the fruit resulted in from open pollination treatment tended to have the lowest fruit firmness within both seasons.

During both 2012 and 2013 seasons, fruit firmness of the three plum cvs. was significantly higher as a result of low number of bee visits/ flower. A significant gradual decrease of fruit firmness was noticed as the number of bee visits/ flower increased. Ten bee visits/ flower significantly reduced fruit firmness than the other lower numbers of visits. The mean of fruit firmness was 1.54, 1.32 and 1.34 lb/inch² for Golden Japanese, Hollywood and Santarosa fruits in 2012, while the self-pollinated flowers showed the highest significant fruit firmness, followed by a single bee visit/ flower for the three studied cvs. Same trend was observed in 2013.

Table 5: Effect of number of bee visits/ flower on fruit firmness (lb/inch²) of three Plum varieties during two successive seasons, (2012-2013).

No. Of bees/ Flower	Golden Japanese		Hollywood		Santarosa		Mean/No. of bees
	2012	2013	2012	2013	2012	2013	
Zero	9.91	9.71	8.91	9.46	7.93	9.58	9.25 ±0.298 A
1	7.63	7.60	7.14	7.33	7.41	7.20	7.38 ±0.082 B
2	6.65	6.88	6.35	6.13	6.46	6.26	6.45 ±0.112 C
3	5.87	5.98	5.21	5.27	5.61	5.49	5.57 ±0.127 D
4	4.90	5.04	4.31	4.59	4.46	4.24	4.59 ±0.131 E
5	4.02	4.12	3.81	3.58	3.71	3.52	3.79 ±0.098 F
6	3.38	3.20	2.93	2.81	3.12	3.04	3.08 ±0.082 G
7	2.79	2.69	2.50	2.41	2.55	2.60	2.59 ±0.056 H
8	2.34	2.29	1.97	2.01	2.20	2.10	2.15 ±0.062 I
9	1.81	1.88	1.63	1.59	1.72	1.69	1.72 ±0.044 J
10	1.54	1.43	1.32	1.37	1.34	1.47	1.41 ±0.035 K
Open Pollination	1.28	1.21	1.03	1.06	1.16	1.11	1.14 ±0.039 L
Mean ±SE	4.342 ±0.782 a	4.334 ±0.786 b	3.924±0.729 e	3.967 ±0.763	3.971±0.688 d	4.024±0.756 c	4.09

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

Previous findings emphasize that cross-pollination resulted in softer fruits compared to the other tested pollination regimes. The above results agree with Hassan *et al.* (2007) on plum. Firmest fruits were those obtained from non-pollinated regime (Arafat *et al.*, 1994; Stinoet *et al.*, 2001; Yehiaet *et al.*, 2008 and El-Dereny, Sarah, 2010) on apple.

A highly significant negative relation was existed between fruit firmness and the number of bee visits. Increasing the number of bee visits/ flower led to more fruit softness. A clear improvement was noticed in fruit firmness with increasing bee visits/ flower to 10 where it reached 84.9%, 85.4% and 83.9% softness for Golden Japanese, Hollywood and Santarosacs., respectively.

Plum is completely self-incompatible and must be cross-pollinated with pollen from a different plant variety. In planting an orchard, it is necessary to select compatible varieties whose blooming periods overlap.

This investigation concentrated on the relationship between bee activity on plum flowers and its impact on fruit set as well as certain main fruit characteristics

under cross-pollination. Generally, it may be concluded from the obtained results that pollination is a limiting factor in fruit set. This work focused on studying the relationship between the number of bee visits and the extent of improvement that might happen in fruit characteristics. Hence, insufficient cross-pollination is one of the most important factors responsible for low productivity in plum (Hassan *et al.*, 2007 and Sapir *et al.*, 2007) and El-Dereny, Sarah (2010) on apple and almond fruits.

It further indicated a significant benefit for Golden Japanese, Hollywood and Santarosacvs., in respect of final fruit set as well as fruit characteristics including fruit weight, volume, length, diameter, firmness and T.S.S. as a result of increased honey bee visits/ flower. In addition, the fruit quality and grade improved with decrease in fruit firmness.

Based on the work of others (Free, 1993; Calzoni and Speranza, 1996; 1998; Delaplane and Mayer, 2000; Abdelaziz, *et al.*, 2005; Guerra, 2010 and Guerra and Rodrigo, 2015) on plums, (Arafat *et al.*, 1994; Abd elaziz *et al.*, 1999; Stern *et al.*, 2001; Stino *et al.*, 2001 and Yehia *et al.*, 2008) on apples and El-Dereny, Sarah(2010) on apple and almond, they presented that increasing bee activity would improve cross-pollination and, subsequently, fruit set and yield were increased.

It is recommended, therefore, that securing sufficient numbers of honeybee colonies prior to the flowering season of Golden Japanese, Hollywood and Santarosa plum cvs. secures high productivity in terms of fruit set and fruit characteristics which are regarded as the main components of productivity efficiency.

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ARABIC SUMMARY

العلاقة بين شغالات نحل العسل وبساتين البرقوق II. دورها كملقح على عقد الثمار والجودة

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أجريت هذه الدراسة على أشجار برقوق عمر 20 سنة لأصناف Golden Japanese، Hollywood و Santarosa نامية فى مزرعة خاصة بمحافظة القليوبية خلال موسمى 2012 و 2013. استهدفت الدراسة بحث تأثير عدد زيارات شغالات نحل العسل لأزهار البرقوق على نسبة العقد ومواصفات الثمار الناتجة. أجريت العديد من المعاملات بتعريض أزهار الأصناف محل الدراسة إلى عدد من الزيارات تتراوح من 1 إلى 10 زيارات للزهرة بجانب معاملة بدون زيارات لشغالات نحل العسل بالإضافة إلى معاملة للتلقيح المفتوح. أوضحت النتائج أن زيادة عدد زيارات شغالات نحل العسل للأزهار أدت إلى زيادة معنوية فى نسبة عقد الثمار، حيث كانت النسب 18,7%، 27,5%، 86,7%، 95,7%؛ 28,6%، 91,3% وذلك لموسم 2012 و 19,7%، 87,5%، 26,9%، 96,0%؛ 26,1%، 94,7% لموسم 2013 للثلاث أصناف التى تم دراستها ومعاملات التلقيح الذاتى والتلقيح الحشرى المفتوح، على التوالى.

كما أوضحت الدراسة تأثير إيجابى لخصائص الثمار نتيجة لزيادة أعداد النحل الزائر/ الزهرة حيث أظهرت زيادة معنوية فى وزن الثمار حيث كان متوسط وزن الثمار الناتجة من التلقيح الذاتى المفتوح 19,93 جم، 27,10 جم، 28,16 جم، للأصناف المدروسة على التوالى. وأستمر ذلك التحسين المعنوى ليصل إلى 84,00 جم، 95,75 جم، 89,97 جم للتلقيح الحشرى المفتوح فى موسم 2012. نفس اتجاه النتائج فى الزيادة المعنوية لوزن الثمار تحقق فى الموسم التالى للدراسة 2013.

أيضا أدت زيادة عدد زيارات شغالات نحل العسل للأزهار إلى زيادة معنوية فى حجم الثمار وكذلك نسبة المواد الصلبة الكلية الذائبة مع إنخفاض معنوي فى الصلابة وذلك لأصناف البرقوق التى تم دراستها خلال موسمى الدراسة. وبناء على نتائج هذه الدراسة يمكن التوصية بتوفير عدد مناسب من طوائف نحل العسل التى توفر على الأقل عدد 10 زيارات للزهرة الواحدة حيث يودى ذلك إلى زيادة نسبة العقد وتحسين معنوي مواصفات جودة الثمار مما يودى إلى زيادة الكفاءة الإنتاجية لبساتين البرقوق.