



Using of synthetic boney bee workers pheromones spray on pollination of apple crop in Egypt

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Abstract

Two Synthetic boney bee workers pheromones were applied to 0.3 feddan of planted of locality variety of apple in Behira Governorate by spray at two times of blooming (50% and 100% bloom) The pheromones were Geraniol and citral at 200 and 400 ppm of both (Nasonov gland pheromones). Results: Showed that there were average of number worker / tree 27.92, 30.48, 36.72 and 38.12 at 50% and 100% blooming after using Geraniol (3days) at 200 and 400 ppm respectively and 31.84, 34.76, 38.97 and 42.12 worker /tree at 50 % and 100 % blooming after using citral at 200 and 400 ppm respectively. On the other hand the average of increased yield was 19.26, 23.61, 21.15 and 25.14 % at 50 and 100 % blooming after using Geraniol 200 and 400 ppm respectively and 18.96, 23.26, 23.50, and 25.24 % at 50 % and 100 % blooming after using citral at 200 and 400 ppm respectively. Recommendation: Industrial used scent gland pheromones for honey bee workers to increase the foraging workers of flowers and thus increase the yield in apples.

Keywords: synthetic boney bee workers, pheromones, pollination, apple

Introduction

Pollination of honey bee, *Apis mellifera* L. is essential for the production of many fruits and vegetables for not only in terms of producing a crop but also because proper pollination is often closely associated with fruit, vegetables and seed quality. In spite of the movement of hundreds and thousands of bees colonies to crops annually, many crops still experience in adequate pollination, resulting in reduced yields, occasional crop failures and lowered crop quality^[1-6]. The queen mandibular pheromone was used as a bee attractant for crops pollination,^[7] Honey bee is asocial insect that lives in a community in which the behavior of all individuals is highly controlled by a group of substances called pheromones secreted by both workers and Queen in Europ which was cool after the spray application and some first damage occurred. However, increasing the number of bees only 1-2 days may supplement pollination enough to improve yield in orchard crop like Apple and Pear if environmental conditions are suitable, a single colony will provide enough bees to sufficiently pollinate 0.08 Hectare of apple in one day. The effective pollination period, declined as the longevity at the ovules minus the time lay between pollination and fertilization is effected by temperature. In delicious apple, low temperatures during the bloom and pest bloom period can slow pollen tube growth enough so that only flowers that are pollinated in the first days of bloom will set fruit^[7, 8].

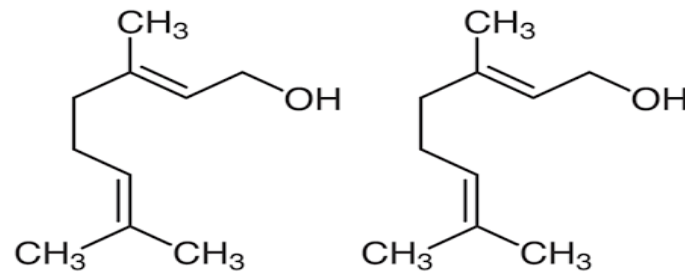
The purpose of this study was to examine the effectiveness of two concentrations of Nasonov gland pheromones (Geraniol and Citral) in honey bees to Apple crop to assess the effect of the timing and number of applications of pheromone sprays on the yield at Apple.

Materials and Methods

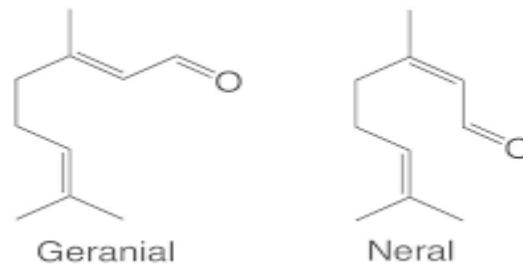
The experiments were carried out at Noubaria, Beheira, Governorate during blooming of Apple crop (*Malus domestica*) fam: Rosaceae, Februray 2021 planted with trees of locality variety of Apple (Anna /106). The acre has 160-170 trees / Feddan were planted in alternative rows (the trees five year age).

The attractants used: the most attractive pheromone at the Nasonov gland pheromones complex, Geraniol and Citral at the favorable concentrations 300 P.P.m.^[9-13]

Treatment was applied at concentration 200 and 400 ppm of both Geraniol and Citral artificial honey bee workers pheromones.

Active components of honey bee workers Nasonov pheromones

Chemical structure of Geraniol



Citral (C₁₀H₁₆O) 3, 7 dimethyl -2, 6-octa dienal or lemonal.

Concentrations used: 200 and 400 ppm/ Feddan. Applied at 50% and 100 % bloom (spray) by rate 80 liters / Feddan (Fed.)

The pheromone was mixed with water and applied by a sprayer at 80 liters / Fed. at 2 times of spraying. One spray at early (50%) bloom and one spray at late (100%) bloom.

Four treated rows were randomly (60 trees)

1. Row (1)= 5 trees at 50 % + 5 trees 100 % bloom + 5 trees for control At concentrations 200 ppm for Geraniol pheromone.
2. Row (2)= the same before as concentrations 400 ppm
3. Row (3)= 5 trees at 50 % + 5 trees 100 % bloom + 5 trees for control At concentrations 200ppm for Citral pheromone.
4. Row (4)= the same before Row (3) at conc. 400 ppm/ tree. The recorded numbers of honey bee workers / tree for one min. at hour 9, 11 AM, 1,3,5 PM. before and after treatment for a period 2 days application was repeated one time. Three honey bee colonies / feddan of Apple, each at which contained 9 wax combs with covered bees of them 4 brood combs + 2 honey comb + 2 pollen comb.

Yield calculated in June 2021: the percentage at the increased weight of fruit kg. / tree was calculated using to the following formula.

$$\text{Increase \%} = \frac{\text{Mean of weight (Kg.)/ tree (after treatment)} - \text{Mean at weight (Kg.)/ tree (untreated)}}{\text{Mean of weight (Kg.)/ tree (after treatment)}} \times 100$$

Statistical analysis: was determined according to [14, 15].

Results and Discussion**Application of Geraniol pheromone**

- a. Data presented in Table (1) show that the mean numbered bee / tree / min. at 200 ppm conc. With 50 % blooming were 27.92±0.39 and percentage increase of yield apple crop 19.26 % but at 400 ppm conc. were 30.48±1.33 and 23.61%, respectively compared the control (16.64±0.90 bee / tree / min.). *P-value* was 0.0304* significant.
- b. According the table (2) there was the mean number at bee and % increased at yield were 36.72±1.08, 21.15 %, 38.12±2.06, and 25.14 % at 200 and 400 ppm concentration with 100% blooming, respectively. Compared the control (16.88±0.69 bee / tree / min.). *P-value* was 0.0265* significant.

Application of Citral pheromone

- a. According to table (3) the average number at bee / tree / min and % increased of yield were 31.84±1.87, 18.96 %, 34.76±0.89, 23.26 % at 200 and 400 ppm concentrations with 50 % blooming, respectively. Compared the control (16.68±0.43 bee / tree / min.). *P-value* was 0.0013** highly significant.

- b. Data presented in table (4) the average number of bee/ tree / min. and increased of yield were 38.96 ± 1.15 , 23.5% , 42.12 ± 1.09 , 25.24% at 200 and 400 ppm conc. with 100 % blooming, respectively. Compared the control (17.64 ± 0.48 bee / tree/ min.). *P*-value was 0.1456 non-significant.

These results confirmed the results ^[16] that increasing the number of honey bee foragers may be one of the most effective ways to increase fruit set in Delicious apple. Abou-Lila ^[17] she studied the effect of applying artificial queen pheromone in queen less colonies as compared of queen less colonies and normal queen right colonies (untreated). The statistical analysis as shown was significant between plants (Crawway and Clover) in product resulting from higher number of honey bee foragers of pheromone treated plots ^[18]. Increasing in total weight and value of the harvestable crop ^[19].

Generally

Scent gland pheromones, the artificial using on apple trees, led to an increase in the foraging workers on the flowers. This increase the yield in the treated trees for untreated (control).

Table 1: Mean number of the effect of application at two concentrations of the synthetic honey bee workers pheromones on the number of foraging honey bee and apple crop weight at 50 % blooming.

Treatment	Bees No. before Treat	Bees No./tree/min. after treatment \pm SD					Bees No./tree /min. \pm SD	Weight of fruits/Kg/tree \pm SD	% Increasing Of crop	<i>P</i> -value
		9 AM	11AM	1PM	3PM	5PM				
Geraniol 200 ppm	16.2	28.4 \pm 1.83	37.6 \pm 2.07	28.8 \pm 0.84	24.8 \pm 1.79	20.0 \pm 1.41	27.92 \pm 0.39	50.8 \pm 1.04	19.26	0.0304*
Geraniol 400 ppm	16.4	30.4 \pm 1.14	37.6 \pm 2.30	31.4 \pm 3.44	26.2 \pm 0.84	20.8 \pm 7.16	30.48 \pm 1.33	53.7 \pm 1.20	23.61	
Control	16.2	17.8 \pm 1.84	17.0 \pm 1.00	16.0 \pm 1.41	16.4 \pm 2.30	16.0 \pm 1.87	16.64 \pm 0.90	41.0 \pm 0.61	-	-

Table 2: Mean number of the effect of application at two concentrations of the synthetic honey bee workers pheromones on the number of foraging honey bee and apple crop weight at 100 % blooming.

Treatment	Bees No. before Treat	Bees No./tree/min. after treatment \pm SD					Bees No./tree /min. \pm SD	Weight of fruits/Kg/tree \pm SD	% Increasing Of crop	<i>P</i> -value
		9 AM	11AM	1PM	3PM	5PM				
Geraniol 200 ppm	17.8	41.8 \pm 3.11	40.4 \pm 2.70	36.0 \pm 1.41	33.4 \pm 3.13	32.0 \pm 2.92	36.72 \pm 1.08	53.9 \pm 1.75	21.15	0.0265*
Geraniol 400 ppm	17.4	44.0 \pm 2.92	45.8 \pm 3.27	37.2 \pm 3.27	33.2 \pm 3.11	30.4 \pm 4.83	38.12 \pm 2.06	55.0 \pm 2.31	25.14	
Control	17.8	17.6 \pm 1.82	18.0 \pm 1.22	16.4 \pm 1.14	16.8 \pm 1.30	15.6 \pm 0.89	16.88 \pm 0.69	42.5 \pm 1.58	-	-

Table 3: Mean number of the effect of application at two concentrations of the synthetic honey bee workers pheromones on the number of foraging honey bee and apple crop weight at 50 % blooming.

Treatment	Bees No. before Treat	Bees No./tree/min. after treatment \pm SD					Bees No./tree /min. \pm SD	Weight of fruits/Kg/tree \pm SD	% Increasing Of crop	<i>P</i> -value
		9 AM	11AM	1PM	3PM	5PM				
Citral 200 ppm	16.6	30.4 \pm 1.14	36.6 \pm 3.21	34.6 \pm 4.45	30.8 \pm 3.56	28.8 \pm 2.17	31.84 \pm 1.87	53.6 \pm 1.98	18.96	0.0013**
Citral 400 ppm	16.4	33.6 \pm 3.65	40.8 \pm 2.28	35.6 \pm 2.88	31.4 \pm 2.51	30.4 \pm 1.67	34.76 \pm 0.89	56.6 \pm 2.16	23.26	
Control	16.8	17.2 \pm 1.18	17.8 \pm 1.14	16.2 \pm 1.30	16.4 \pm 1.14	16.2 \pm 0.84	16.68 \pm 0.43	43.4 \pm 1.19	-	-

Table 4: Mean number of the effect of application at two concentrations of the synthetic honey bee workers pheromones on the number of foraging honey bee and apple crop weight at 100 % blooming.

Treatment	Bees No. before Treat	Bees No./tree/min. after treatment \pm SD					Bees No./tree /min. \pm SD	Weight of fruits/Kg/tree \pm SD	% Increasing Of crop	<i>P</i> -value
		9 AM	11AM	1PM	3PM	5PM				
Citral 200 ppm	19.0	42.4 \pm 3.05	45.0 \pm 1.58	40.0 \pm 1.58	35.4 \pm 3.78	32.0 \pm 2.12	38.96 \pm 1.15	58.1 \pm 1.52	23.50	0.1456
Citral 400 ppm	18.0	45.6 \pm 2.70	47.4 \pm 1.52	42.8 \pm 1.92	40.4 \pm 1.14	34.2 \pm 1.64	42.12 \pm 1.09	59.4 \pm 0.65	25.24	ns
Control	17.8	17.6 \pm 1.14	18.2 \pm 1.30	18.0 \pm 1.58	17.4 \pm 1.95	17.0 \pm 1.41	17.64 \pm 0.48	44.4 \pm 1.08	-	-

Table 5: Mean number of seeds in fruit

Concentration	Geraniol \pm SD		Citral \pm SD		P-value
	At 50% flowering	At 100 % flowering	At 50% flowering	At 100 % flowering	
200 ppm	3.6 \pm 0.55	4.0 \pm 0.71	4.8 \pm 0.84	5.2 \pm 0.45	0.0705*
400 ppm	5.0 \pm 0.71	5.4 \pm 0.84	5.6 \pm 0.55	5.8 \pm 0.45	
Control	2.8 \pm 0.45	3.0 \pm 0.89	3.0 \pm 0.71	3.4 \pm 0.55	-

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