

A STUDY OF DEFENSIVE BEHAVIOUR IN SOME HONEYBEE RACES

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ABSTRACT

Two races of the honeybees and their F₁ hybrid were evaluated with regard to their defensive behaviour. The Syrian race revealed a highly defensive behaviour, while the Carniolan race showed a mild defensive response. The F₁ hybrid bees ranked between the two races. These conclusions were based on the number of stings per ball before and after smoking under various treatments at three different positions. Human sweat and geraniol were more effective, inducing aggressiveness and severe stinging more than perfume and citral chemicals. Opening the hive or exposing the balls to workers on the comb tops after hitting the lid and removing it increased the aggressive behaviour. The smoke significantly reduced the aggressive behaviour of the honeybee workers.

INTRODUCTION

Social insects in general are more likely to sting when they are disturbed, as a defensive behaviour to protect the nest and ensure the viability of the colony. According to Free (1961), Villa (1988) and Andere *et al.* (2000), the assays most commonly used to activate defensive behaviour include moving objects made of muslin or leather in front of the hive entrance. Aggressiveness against a leather ball shaken in front of the hive is more intense when the ball is impregnated with 2-heptanone or isopentyl acetate (Free and Simpson, 1968). Hunt *et al.* (1998) pointed out that several related components that can serve as measures of defensive behaviour, such as stinging, the time to respond for stinging, the number of individuals recruited to sting will pursue the target. The number of stings received is probably a more reliable measure than the response time when breeding for gentleness (Guzman-Novoa and Page, 1993). Michener (1975) showed that the aggressiveness varies greatly among races, even among the colonies of the same race and also due to certain conditions such as swarming during spring or during the honey-flows, hot or cold weather and when the bees are badly handled. After three generations of backcrossing Africanized to Carniolan bees, the progeny showed reduced colony defense (Kurlotto, 1975).

The aim of the present investigation is to compare two races of honeybees, the Syrian race *A. mellifera syriaca*, Carniolan race *A. mellifera carnica* and their F₁ hybrid with regard to their defensive behaviour, using chemicals, different positions and before and after smoking.

MATERIAL AND METHODS

Five colonies of each of the Syrian and Carniolan races and their F₁ hybrid were established for the experiments. Syrian and newly mated queens were brought from the Syrian Beekeeping Development Project, Damascus.

Syria. Carniolan queens were brought from the Egyptian Ministry of Agriculture and Land Reclamation. F₁ hybrid was obtained when Syrian virgin queens were naturally reared from mother colonies, then transported into Benton cages to an isolated location for Carniolan colonies in the North of Delta.

Assays most commonly used to evaluate defensive behaviour of honeybees include the use of tethered moving objects. Stinging is the only possible final behaviour in a sequence of acts by a honeybee, that are collectively called defensive behaviour (Collins *et al.*, 1980). There are several components that can serve as measures of stinging behaviour of which the number of stings left in the target (ball) was chosen in this study.

The defensive behaviour was evaluated in the two races and their F₁ hybrid. Four replicates of each were raised by using a method developed by Stort (1974). The tests were carried out from the first of June until the end of August, 2000. The colonies were approximately equalized in their strength (7-8 combs/colony). Temperature ranged between 26 and 36°C, and relative humidity between 64 and 79% in June, July and August. To minimize the exchange of workers, the colony which was subjected to test was chosen at the distance of about 5 meters from the other tested colony. The trials were conducted between 9.30 and 11.30 a.m. To apply the tests, balls were of the same volume (about 12 cm in diameter). Each ball consisted of newspaper pieces enveloped by a cotton layer and covered with dark blue socks and joined together with thread (50 cm in length).

To study the effects of some material odours on stinging behaviour, human sweat, perfume, citral and geraniol were tested. To evaluate the human sweat scent, balls were partially covered by cloth containing human sweat. Meanwhile, for testing other mentioned materials, each was prepared as a solution at the concentration of 1% by volume according to Collins *et al.* (1993).

The tests were conducted at three positions, at the hive entrance (position a), on the comb tops (position b) and on the comb tops after hitting and removing the lid (position c). These experiments were carried out after smoking and without smoking. Different balls were used for each treatment and each position for the same colony.

For the application of each chemical, the used amount was sprayed on the ball surface and distributed in a uniform manner. Untreated balls were also used at the three mentioned positions. The tests were performed at 3-4 days intervals for the same colony to allow the bees to return to a completely normal state (Guzman – Novoa *et al.*, 1999).

In order to trigger the defensive behaviour of the colony, a ball was rhythmically waved (elevated 4 cm and lowered 4 cm about two swings per second) approximately 5-10 cm in front of the entrance of each hive according to Villa (1988). The bees were permitted to sting for a period of one minute after the first sting. At the end of each test the balls were individually packed, sealed in plastic bags and stings were counted in the laboratory.

The F test was applied for the analysis of variance. The L.S.D was used to determine the significant differences between the means according to Snedecor and Cochran (1971).

RESULTS AND DISCUSSION

Two races of the honeybees and their F_1 hybrid were evaluated with regard to their defensive behaviour under various treatments and positions. The results are given in Table (1) and the statistical analyses are presented in Tables 2, 3 and 4.

1 -Balls treated with human sweat:

In case of smoking application, the mean numbers of stings received by balls treated with human sweat and exposed to the workers at position (a) were 37.75 in the Syrian race and 20.75 in the F_1 hybrid bees. The corresponding number of stings in the Carniolan race was 18.25. A similar trend was noticed at positions (b) and (c).

Concerning the non-smoking application, a similar picture was also detected at the positions (a), (b) and (c) between the two experimental races and their F_1 hybrid bees (Table 1).

2 -Treatment with perfume:

Under smoking condition, the highest mean of stings per ball at position (a) was 37.50 in the Syrian race, followed by F_1 hybrid bees (22.25). The lowest mean of 13.00 occurred with the Carniolan race. A similar trend was detected at positions (b) and (c) and also in case of the non smoking conditions between the two races and their F_1 hybrid at the three different positions (Table 1).

3 -Treatment with citral:

Under smoking application, the number of stings was 25.75 in the Syrian race, followed by the Carniolan race (14.25) and 10.00 for the F_1 hybrid bees. The Syrian race exhibited the highest means at positions (b) and (c), followed by the F_1 hybrid. The lowest figure was recorded in the Carniolan race.

In case of the non-smoking condition at position (a) the means were 80.25, 35.75 and 28.25 in the Syrian race, F_1 hybrid and Carniolan race, successively. Positions (b) and (c) showed identical pictures (Table 1).

4 -Treatment with geraniol:

Under smoking application, the highest mean number of strings per ball at position (a) was 39.25 in case of F_1 hybrid bees. The Syrian race came next and showed 36.25. The Carniolan race exhibited the lowest mean of 26.25. Positions (b) and (c) gave the highest means in the Syrian race, followed in a descending order by the F_1 hybrid and the Carniolan race.

Concerning the non-smoking application, the means at position (a) were 111.00, 35.50 and 31.00 in the Syrian race, Carniolan race and F_1 hybrid, respectively.

At positions (b) and (c), the Syrian race showed the highest means, followed by F_1 hybrid. The lowest means were recorded in the Carniolan race.

5 -Untreated balls:

In case of untreated balls under smoking and non-smoking applications at the three different positions, the same trend was detected, where the Syrian race showed the highest means, followed by the F_1 hybrid. The lowest means were recorded in the Carniolan race.

Table (1): Mean number of stings per ball under various treatments and different positions either after smoking or non-smoking applications.

Race Position	Syrian				Carniolan				F ₁ Hybrid			
	a	b	c	Mean	a	b	c	Mean	a	b	C	Mean
Treatment												
Smoking	37.75	57.25	86.75	60.58	18.25	31.25	53.75	34.42	20.75	44.00	68.50	44.42
	Human sweat											
Without smoking	80.50	98.75	140.75	106.67	54.50	73.00	89.50	72.33	60.00	83.00	114.00	85.67
Smoking	37.50	50.75	107.25	65.17	13.00	26.50	35.25	24.92	22.25	30.50	79.00	43.92
	Perfume											
Without smoking	55.75	88.00	121.00	88.25	29.50	41.50	64.50	45.17	36.50	53.75	119.00	69.75
Smoking	25.75	43.25	84.00	51.00	14.25	25.75	44.25	28.08	10.00	36.75	46.00	30.92
	Citral											
Without smoking	80.25	101.50	156.00	112.58	28.25	45.00	58.00	43.75	35.75	55.75	99.00	63.50
Smoking	36.25	66.25	130.00	77.50	26.25	43.50	65.25	45.00	39.25	62.00	94.00	65.08
	Geraniol											
Without smoking	111.00	138.75	177.50	142.42	35.50	59.00	83.50	59.33	31.00	81.00	121.50	77.83
Smoking	32.25	51.75	84.25	56.08	6.50	14.75	28.25	16.50	16.25	35.00	63.75	38.33
	Untreated											
With smoking	59.25	67.00	114.50	80.25	12.50	24.00	52.50	29.67	23.75	63.00	89.00	58.58

A = at the hive entrance, b = on the comb tops and c = on the comb tops after hitting. Each mean is represented by four replicates.

Concerning the differences between the two races and their F₁ hybrid under various treatments and positions, the statistical analysis in Table (2) shows that significant differences occurred between the mean number of stings per ball before and after smoking for each tested bees. Similar significant differences were obtained between smoking and non-smoking applications, as well as between the different positions for each tested race (Tables 3 and 4).

Table (2): Mean number of stings per ball between the tested bees under various treatments and different positions before and after smoking.

Treatment	Human sweat	Perfume	Citral	Geraniol	Untreated
Race					
Syrian	83.63 ^a	76.71 ^a	81.79 ^a	109.96 ^a	68.17 ^a
Carniolan	53.38 ^c	35.04 ^c	35.92 ^c	52.17 ^c	23.08 ^c
F ₁ Hybrid	65.04 ^b	56.83 ^b	47.21 ^b	71.46 ^b	48.46 ^b
L.S.D.	11.58	13.23	10.50	13.22	4.76

Means followed by the same letter in the same column are not significantly different according to L.S.D._{0.05}.

Table (3): Mean number of stings per ball before and after smoking for each tested bees under various treatments and different positions.

Race		Syrian					Carniolan					F ₁ Hybrid				
Smoking	Treatment	Human Sweat	Perfume	Citral	Geraniol	Untreated	Human Sweat	Perfume	Citral	Geraniol	Untreated	Human Sweat	Perfume	Citral	Geraniol	Untreated
	Smoking		60.58 ^b	65.17 ^b	51.00 ^b	77.50 ^b	56.08 ^b	34.42 ^b	24.92 ^b	28.08 ^b	45.00 ^b	16.50 ^b	44.42 ^b	43.92 ^b	30.92 ^b	65.08 ^b
Without Smoking		106.67 ^a	88.25 ^a	112.58 ^a	142.42 ^a	80.25 ^a	72.33 ^a	45.17 ^a	43.75 ^a	59.33 ^a	29.67 ^a	85.67 ^a	69.75 ^a	63.50 ^a	77.83 ^a	58.58 ^a
L.S.D.		9.46	10.80	8.57	10.80	3.89	9.46	10.80	8.57	10.80	3.89	9.46	10.80	8.57	10.80	3.89

Means followed by the same letter in the same column are not significantly different according to L.S.D._{0.05}.

Table (4): Mean number of stings per ball at different positions for each tested bees under various treatments before and after smoking.

Race		Syrian					Carniolan					F ₁ Hybrid				
Position	Treatment	Human Sweat	Perfume	Citral	Geraniol	Untreated	Human Sweat	Perfume	Citral	Geraniol	Untreated	Human Sweat	Perfume	Citral	Geraniol	Untreated
	a		59.13 ^c	46.63 ^c	53.00 ^c	73.63 ^c	45.75 ^c	36.38 ^c	21.25 ^b	21.25 ^c	30.88 ^c	9.50 ^c	40.38 ^c	29.38 ^b	22.88 ^c	35.13 ^c
b		78.00 ^b	69.38 ^b	72.38 ^b	102.50 ^b	59.38 ^b	52.13 ^b	34.00 ^b	35.38 ^b	51.25 ^b	19.38 ^b	63.50 ^b	42.13 ^b	46.25 ^b	71.50 ^b	49.00 ^b
c		113.75 ^a	114.13 ^a	120.00 ^a	153.75 ^a	99.38 ^a	71.63 ^a	49.88 ^a	51.13 ^a	74.38 ^a	40.38 ^a	91.25 ^a	99.00 ^a	72.50 ^a	107.75 ^a	76.38 ^a
L.S.D.		11.58	13.23	10.50	13.22	4.76	11.58	13.23	10.50	13.22	4.76	11.58	13.23	10.50	13.22	4.76

Mean followed by the same letter in the same column are not significantly different according to L.S.D._{0.05}.

It is obvious that opening the hive or exposing the balls to workers on the comb tops after hitting and removing the lid markedly encouraged the bees to be aggressive. This result may be explained according to Wenner (1970) who stated that the sound induced alarm signals which raised the defensive behaviour among the bees. This was strongly observed in the Syrian bees.

The results also indicated that human sweat and geraniol were more effective causing aggressiveness and severe stinging more than perfume and citral. Free (1961) stated that bees are more encouraged to sting by the presence of a dark colour, scent venom and animal and human sweat.

Smoking also reduced the aggressive behaviour of bees. This may be due to mask on the alarm pheromone scent or induce the bees to fill up with honey. Therefore, the tendency to sting is reduced (Newton, 1967 and El-Ansary, 1998).

With regard to the present results, it could be concluded that the Syrian race revealed the highest defensive behaviour, while the Carniolan bees were more gentle, easily handled and showed mild defensive responses. The F₁ hybrid bees ranked between the two races. These results are supported by the findings of Edris (1979) that the Syrian race is characterized by aggressiveness, especially when the food is not enough, causing the bees to highly defend the hive against the enemies.

In accordance with these results, Ruttner (1975), Page and Laidlow (1980), Cobey (1992) and Degrandi-Hoffman (1998) suggested that the Carniolan race is characterized by gentleness and is easily handled without smoking.

In conclusion, the hybridization between the Syrian and the Carniolan races reduced the aggressive behaviour in their F₁ hybrid workers. Therefore, the honey bee aggressiveness or calmness is an important factor for the beekeepers. This aggressive behaviour can affect the ease and enjoyment of managing the colonies, since stinging is considered a major nuisance.

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دراسة السلوك الدفاعي في بعض سلالات نحل العسل

وفاء يعقوب ، نبيل البربري ، أسلمة الأنصاري و عباس عبد اللطيف
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تمت المقارنة بين سلالتين من نحل العسل هما سلالة النحل السوري وسلالة النحل الكرنبولي وكذلك الهجين الأول بينهما وذلك من حيث السلوك الدفاعي. ولقد تم اختبار تأثيرات بعض مواد الرائحة مثل عرق الإنسان والجيرانبول والسترال والبارفان وذلك على سلوك اللسع وتم تحديد النتيجة على أساس عدد اللسعات التي تلقتها كرة الاختبار وذلك باستخدام التدخين أو بدونه في جميع المعاملات وكانت النتائج المتحصل عليها كالتالي:

- أظهرت سلالة النحل السوري أعلى سلوك دفاعي.
- سلالة النحل الكرنبولي كانت أكثر هدوءاً ويسهل التعامل معها وأظهرت سلوكاً دفاعياً معتدلاً.
- احتل الهجين الأول مرتبة متوسطة بين السلالتين في الغالبية العظمى لجميع المعاملات.
- كانت رائحة عرق الإنسان والجيرانبول العامل الأكثر تأثيراً في الحد على الشراسة وزيادة عدد اللسعات لكل كرة عن المواد الأخرى.
- فتح الخلية أو تعريض الكرات للشغالات فوق قمة الأقراص بعد الطوق على الغطاء وإزالته أدى إلى زيادة شراسة النحل بصورة واضحة.
- استخدام التدخين يعتبر عاملاً هاماً في تقليل السلوك الشرس للنحل.