

Tolerance of Summer Temperature in Imported and Indigenous Honeybee *Apis mellifera* L. Races in Central Saudi Arabia

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Abstract

Workers from Yemeni (indigenous), Carniolan, and Italian honeybee *Apis mellifera* races were compared in tolerating air temperature during summer season. After two hours from 8 to 10 am of being shaded, Yemeni workers showed significantly lower weight loss than Carniolan and Italian workers. Foraging activity was monitored for the first 10 minutes of each hour (8 and 10 am) and showed that foraging workers from Yemeni colonies were higher than those of Carniolan and Italian. Italian colonies showed the lowest values in tolerating summer temperature and foraging activity under Riyadh conditions.

Key words: *Apis mellifera*, Honeybee, Indigenous race, Summer temperature, Weight loss, Foraging activity.

Introduction

Honeybee keeping in Saudi Arabia faces the challenge of arid zone conditions where summer temperature often exceeds 45° C. Corbet *et al.* (1993) stated that among several abiotic factors temperature has been mentioned as the most important that have an effect on honeybee activity. Al-Kahtani (2003) evaluated the performance of honeybee colonies supplied with ventilation units in Al-Hassa region and reported significant differences in colony temperature during winter and summer seasons.

The high temperature affects negatively queen's egg laying, bee foraging activity, and nectar secretion in flowers (Gary, 1999). During summer season, bee foraging in Riyadh area takes place early in the morning while temperature is temporary low and nectar still available in flowers. Alqarni (1995) reported that honeybee colonies in Riyadh area commence foraging just ahead of sunrise. Pollen supplementary feeding was very essential for colonies during summer season under Riyadh area conditions (Alghamdi, 2002).

In spite of these environmental challenging

conditions, the number of apiaries within farms increased from 4 in 1987 to 292 in 2000 (Alhadithi, 2003). However, limited vegetation in farms does not grant year round honey and pollen sources for bee colonies. Therefore, most beekeepers perform migratory beekeeping to avoid demanding weather conditions and the adverse consequences of food deficiency in farms. Wild nectar and pollen plants such as *Astragalus spinosus*, *Horwoodia dicksoniae*, *Anisosciadium isosciadium*, *Citrillus coloyntis*, *Achillea fragrantissima*, *Capparis spinosa*, *Acacia spp.*, and *Ziziphus spina-christi*, are available for bees after rainy season in addition to alfalfa, eucalyptus, sun flower, date palm trees, and some fruit trees (Alghoson, 2004; Aloraydh and Alfarraj, 1998). Beekeepers follow the flowerings of these plants within a circle of 400- 500 km diameter in the central area of the country.

About 70- 80 % of the bees kept in central Saudi Arabia are Carniolan (*Apis mellifera carnica*) and Egyptian X Carniolan F1 hybrid. The rest is typically indigenous bees *Apis mellifera yementica*, whereas Italian bees *A. m. ligustica* are less found due to less

information available for beekeepers about this race and its performance under Riyadh area conditions.

Many beekeepers reported that the indigenous race surpasses other races in foraging activity and tolerating area conditions. Alqarni (1995) stated that indigenous bees surpassed Carniolan bees in brood production and pollen collection, while honey production was similar in the two races. High brood production in indigenous bees led to fast consumption of honey reserves once summer temperature approaches 40° C. compared to the Carniolan bees

This experiment is part of a whole study that evaluates the performance of indigenous and imported honeybee races under the environmental conditions of central region of Saudi Arabia.

Materials and Methods

The experiment was carried out at the bee research unit of the plant protection department at King Saud University, Riyadh, Saudi Arabia. Indigenous (*Apis mellifera yementica*) queens were obtained from the south of Saudi Arabia while Carniolan (*Apis mellifera carnica*) and Italian (*Apis mellifera ligustica*) queens were obtained from Australia.

Queens were introduced early in the spring to 5 frame nucleus colonies with equal amounts of sealed brood, honey and pollen frames covered with bees. Nucleus colonies were allowed to build up their populations naturally and transferred within a month to full size colonies with 10 frames. Samples of worker bees were taken after new brood cycle was completed and the whole colony population was confirmed to be laid by the introduced queens.

Five colonies from each race were randomly selected for the experiment, and 10 workers were collected every week from the entrance of each colony at 7 am during July-August. Workers were collected by resting a piece of silkscreen on the entrance of the hive to collect only foraging workers. Upon collection in a glass jars, workers were put in the freezer for 5-8 minutes to reduce their movements. Then transferred individually to plastic cages and weighed with the cage (W1). After weighing, the 150 caged workers from the three races were randomly distributed on a wooden plates and left out in a shaded area for 2 hrs and then reweighed (W2). The difference between

W1 and W2 was calculated and the percentage of weight loss was obtained. During the two hours period, foraging activity for the five colonies from each race was monitored for 10 minutes by counting the number of foragers leaving the hive at 8 and 10 am.

Results were analyzed using Minitab Statistic program (Minitab, 2000). One way ANOVA was run to test for significant differences between the three races in weight loss after exposing to summer air temperature. The same test was run to compare the foraging activity at 8 and 10 am during summer season for the three races.

Results and Discussion

Results of this study revealed that the indigenous race have lost significantly less weight than the Carniolan and Italian races ($P = 0.006$) after 2 hrs shaded in the field from 8 am to 10 am. Workers of the three races have lost $0.1386 \text{ mg} \pm 0.1659$, $0.2065 \text{ mg} \pm 0.1320$, and $0.2499 \text{ mg} \pm 0.3399$ respectively (Fig.1).

The ability to tolerate air temperature was reflected

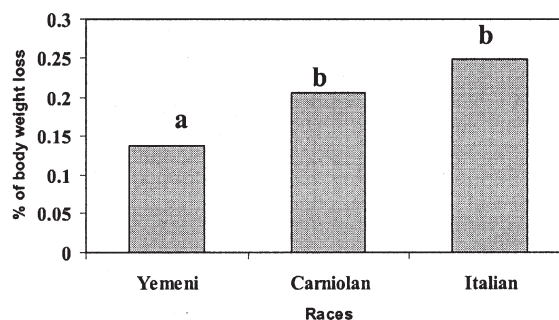


Fig 1. Percentage of body weight loss in workers of Yemeni (indigenous), Carniolan, and Italian honeybee races after 2 hrs shaded under the sun during summer season in Riyadh, Saudi Arabia. (Different letters on bars indicate significant differences at 0.05).

on the foraging activity in the three races. Indigenous bee foraging activity was significantly higher than that of the two other races. Number of foraging workers during 10 minutes of monitoring at 8 am was 893.6 ± 431.2 , 274.9 ± 190.1 and 278.8 ± 165.2 workers, whereas foraging activity at 10 am declined to 104.67 ± 54.68 , 23.33 ± 18.75 and 51.67 ± 9.04 workers for the Yemeni, Carniolan, and Italian races respectively. For all three races, foraging activity was higher at 8.00 am than 10.00 am (Fig. 2).

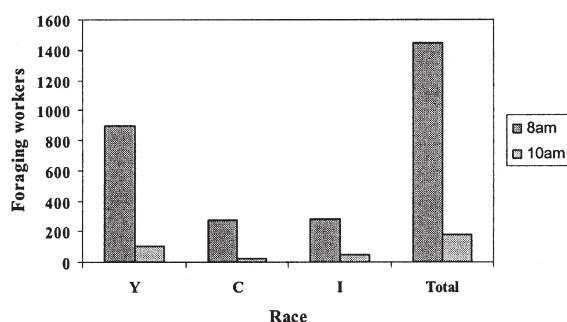


Fig 2. Number of foraging workers from three races (Y: Yemeni, C: Carniolan, I: Italian) during early (8 am) and late (10 am) morning of summer season in Riyadh, Saudi Arabia.

Reduction in foraging activity in late morning was expected due to the increase of air temperature from 33.5°C at 8 am to 37.2°C at late morning (10 am) during the two months of the study. Gary (1967) and Woyke (1992) mentioned that flight activity decreased with the increase of air temperature. According to Lundie (1925) the lowest temperature at which the flights of *A. mellifera* ligustica began was 10°C, but the flight commenced normally between 12°C and 14°C.

On a physiological basis, worker honeybees perform a mechanism called “evaporative cooling” to minimize the adverse effects of high temperature while flying. This mechanism includes releasing a drop of nectar from the honey sac and keeping it on the mouthparts to evaporate and cools the head and thorax (Chapman, 1998). The lowest weight loss recorded in the indigenous bees referred to its smaller size compared to the Carniolan and Italian races. Ruttner (1988) reported that bees collected from three parts of Saudi Arabia were considerably variable but all were extremely small in size. One sample showed the lowest measurements for the species *mellifera*. Alqarni (1995) found that the indigenous bees were significantly smaller in all twelve compared measurements than carniolan bees. In support of the result of this study, ongoing experiment in the same location compares the brood production in the three races reveals that some Italian queens were not able to lay eggs, and some of the eggs did not hatch. Moreover, all of the colonies that were led by Italian queens did not complete their first year under Riyadh conditions, whereas indigenous and carniolan races perform similarly throughout the year (unpublished

data). Failure of Italian queens is due expectedly to high air temperature. Kanbash (1989) reported that brood production and pollen storage in Yemen were higher in Carniolan colonies than in Italian colonies. Al-Kahtani (2003) reported that colonies led by Carniolan queens increased their brood production and lowered their tendency to queen cups building and swarming after being supplied with ventilation units to control colony temperature.

It could be concluded that Italian race might not be successful in central Saudi Arabia compared to the indigenous and carniolan bees. More research is needed on this race in other parts of the country.

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تحمل حرارة الصيف في سلالات نحل العسل *Apis mellifera* L. المحلية والمستوردة في وسط المملكة العربية السعودية

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الملخص

تمت مقارنة تحمل درجة حرارة فصل الصيف في السلالة اليمنية (المحلية) والكرنيولية والإيطالية بمنطقة الرياض. بعد ترك الشغالات من السلالات المدروسة في الظل لمدة ساعتين (٨-١٠ صباحاً) وجد أن السلالة اليمنية أظهرت انخفاضاً معنوياً في الوزن المفقود من الجسم مقارنة بالشغالات الكرنولية والإيطالية. كما أظهرت متابعة نشاط السروح خلال العشر دقائق الأولى من كل فترة (٨ و ١٠ صباحاً) تفوق السلالة اليمنية على السلالتين الأخريين في كمية النحل السارح. وقد أظهرت السلالة الإيطالية قيماً منخفضة في كلا التجريبتين مما يشير إلى حد كبير إلى عدم ملائمتها لظروف المنطقة الوسطى من المملكة.