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EFFECT OF NECTAR FLOW TYPE AND HONEYBEE HYBRID ON DRAWING OUT WAX FOUNDATIONS AND HONEY PRODUCTION OF HONEYBEE, *Apis mellifera* L. COLONIES

Mohamed S.M. Kasim*, S.I.Y. Khalil, S.M.A. El-Shakaa and S.M. Abd-Alla

Plant Prot. Dept., Fac. Agric., Zagazig Univ., Egypt

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ABSTRACT: The present work was carried out in a private apiary located at El-Moullak locality, Abu-Hammad district, Sharkia Governorate, to investigate the performance of Italian and Carniolan honeybee hybrid colonies in drawing out wax foundations and honey production during citrus and clover flow periods of 2014 and 2015 seasons. Summarized results are as follows: based on the two years mean Italian hybrid colonies drew out higher area of wax foundation during clover flow period of 2014 and 2015 seasons, recording 382.5 in^2 *vs* 315 in^2 recorded for Carniolan hybrid. Italian hybrid colonies proved to be more clover honey producers than Carniolan ones. For instance, Italian colonies produced a mean of 9.93 kg clover honey/colony compared to 8.96 kg honey/Carniolan hybrid colony. However, nearly similar quantity of citrus honey recording 8.65 and 8.59 kg citrus honey/Italian and Carniolan colony, respectively.

Key words: *Apis mellifera*, Italian and Carniolan hybrids, wax foundation, citrus and clover nectar flows, honey production.

INTRODUCTION

The productivity of a honeybee colony is multifactorial dependant. However, the number of workers (bee population) is considered one of the main factors in this respect, as the production of the colony of honey, for instance, equal the production of one worker multiplied by the number of workers (**Zmarlicki, 1974 ; Racys, 2002**).

In addition, the race/or hybrid of honeybee plays an essential role, where there are some races of honeybee are more productive in some products than others under varied botanical and meteorological circumstances (**Spivak *et al.*, 1989; Khater, 1998; Salem, 2009**).

Therefore, the present work was conducted to assess the performance of two honeybee hybrids, *i.e.* Carniolan and Italian ones on drawing out wax foundation and honey production during citrus and clover flows of 2014 and 2015 seasons.

* **Corresponding author: Tel. :** +201210003139
E-mail address: Mohamadsalah1000@yahoo.com

MATERIALS AND METHODS

The present investigation was carried out during the period extended from 2013 to 2015. Field experiments were performed in a private apiary located at El-Moullak locality, Abu-Hammad District, Sharkia Governorate, Egypt.

Experimental Honeybee Colonies

A total of eight honeybee nuclei were initiated during late June 2013 and 2014, by division of strong colonies as follows: group A four 5-comb nuclei initiated by division of Carniolan hybrid colonies and group B four 5-comb nuclei initiated by division of strong Italian hybrid colonies. A mated young queen was introduced into each nucleus as follows: group A nuclei (F_1 Carniolan). The introduced four sister queens of the first hybrid Carniolan *(Apis mellifera carnica)*, resulted from open mated virgin queen reared from the progeny of localized Carniolan mother (brought from El-Manzalah District). Group B nuclei (F_1 Italian):

nuclei were provided with four sister queens of first Italian (*A. m. ligustica*) hybrid, resulted from open mated virgins reared from the progeny of imported Italian mother obtained from Honeybee Department, Plant Protection Research Institue, Dokki, Giza. Open mating of virgin Italian and Carniolan queens was carried out at El-Moullak locality, Abu-Hammad District using mated baby nuclei during late May 2013 and 2014. The introduction of mating queens into the experimental nuclei was taken place on the second day of division (nuclei initiation) to ensure rapid and safe queen's acceptance. A half ball netted cage was used for this purpose. All nuclei in each group were equalized as possible in strength, number of combs covered with bees, brood, stored honey and bee bread.

During autumn and winter seasons the experimental colonies were fed on sucrose syrup (1:1 and 2:1) and pollen substitute patties, when necessary to protect colonies from starvation and to maintain the colonies life. In addition, the rate of artificial sucrose feeding was increased, starting from December in both seasons to encourage the queen's egg laying. Moreover, pollen substitute patties, weighing 3/4 kg each, were provided to each experimental colony in late autumn and winter to increase brood rearing activity. The patty consisted of a mixture of 3 parts of defated soyabean flour and one part medical dry yeast in 4:1 sucrose solution, where the mixture of soyabean flour and yeast represented 10% of the total (*W:W*), the remained (90%) is old honey and sucrose. The patties were fortified with lemon juice (0.1%) as a source of vitamin C, and the antiseptic Flagyl syrup (2 ml Flagyl/ 1 kg patty). The patties were offered in closed plastic saccules to prevent them from drying as long as possible. An open window (2 × 10 cm) was made along the saccule side to allow the bees to reach the patty inside.

Drawing Out Wax Foundation

Each test colony of F_1 Carniolan and F_1 Italian hybrids was provided with one wax foundation that was placed at lateral brood nest during citrus and clover flows of 2014 and 2015 seasons. When the wax foundation was completely drawn out, a new foundation was inserted as described above. The drawn out area on both sides of wax foundation was measured by means of Hoffman frame divided into square inches.

Estimation of Honey Production

Citrus honey yield

To produce citrus honey, the test colonies belong to the two hybrids under study were moved to citrus orchards of the Egyptian Agricultural Company at El-Moullak locality, Abu-Hammad District, Sharkia Governorate during the first week of March 2014 and 2015 seasons. The test colonies were fed twice on sucrose syrup (1:1) until the citrus flow has begun, during the third week of March, hence the artificial feeding was stopped and the test colonies were provided with wax foundation combs for drawing and drawn combs for honey storage. Citrus honey was harvested during the first week of April. The surplus honey combs were taken from their respective colonies and marked with paint colour after the bees covering were shaken off. Thereafter, honey yield was estimated for each colony separately (in kg/ colony) by calculating the differences between the weight of honey combs before and after extraction of honey. The extracted combs were then returned back to their respective colonies.

Clover honey yield

After citrus honey extraction, the experimental colonies were moved back to their original site and fed two times on sucrose syrup (1:1) in preparation for clover honey production. Clover flow started at the beginning of May and lasted to the first week of June when the honey yield was estimated for each experimental colony of the two hybrids as described before.

Data obtained were statistically analysed according to **Snedecor and Cochran (1967)** methods, that calculated according to COSTAT Computer Program (**Anonymous, 2005**).

RESULTS AND DISCUSSION

Drawing Out Wax Foundation

Results presented in Table 1 clear the mean drawn area (in^2/colony) of wax foundation by Italian and Carniolan honeybee hybrid colonies during citrus and clover flow periods of 2014 and 2015 seasons.

Table 1. Mean drawn area (in^2/colony) of wax foundation of Italian and Carniolan honeybee hybrid colonies during citrus and clover flow periods of 2014 and 2015 seasons

Honeybee race	Citrus flow		Mean of two years	Clover flow		Mean of two years
	2014	2015		2014	2015	
Italian hybrid	345	390	367.5	270	495	382.5
Carniolan hybrid	345	405	375	345	285	315
Total	690	795	742.5	615	780	697.5
T- test	NS	NS	NS	NS	**	NS

NS: The difference between treatments is Not-significant. **: The difference is highly significant.

Citrus flow

It is clear that Italian and Carniolan colonies drew out the same area of wax foundation (345 in^2/colony) during citrus flow of 2014 season. However, Carniolan colonies exceeded Italian ones in 2015 season recording 405 in^2/colony compared to 390 in^2/colony recorded for Italian colonies.

Generally, the difference between 2014 and 2015 seasons was very slight. Statistical analysis revealed insignificant difference between the two hybrids in 2014 and 2015.

Clover flow

Results obtained clear that the mean drawn out area of wax foundation during clover flow period attained 270 and 495 in^2 ($\overline{X}$= 382.5 in^2 /colony) for Italian colonies and 345 and 285 in^2 ($\overline{X}$ = 315 in^2/colony) for Carniolan colonies in 2014 and 2015 seasons, respectively. Analysis of data manifested statistically highly significant difference in the drawn out area of wax foundation in favour of Italian colonies in 2015 only.

Based on the two years mean Italian hybrid colonies were more active in drawing out wax foundation during clover flow period. On the other hand, Carniolan colonies drew out larger area of wax foundation during citrus flow than that measured during clover flow period, this activity during clover flow period in both seasons. In connection, **Muller (1992)** reported seasonal variation in the amount of wax secreted by bee colonies. In addition, **Starostenko (1971), Skowronek (1976) and Jay and Jay (1983)** reported racial variation in wax production. Morever, **Rashad *et al.* (1980)** stated that the highest wax secretion was taken place during high nectar flows. However**, Jay and Jay (1983) and Whiffler and Hepburn (1991)** found that queen status is greatly effective in this respect. **Szabo (1977)** added that the number of combs built greatly determined by the weight of bees in the colony and air temperature.

Honey Production

Citrus and clover honey yields were estimated during 2014 and 2015 seasons for colonies of both Italian and Carniolan hybrids. Results obtained are presented in Table 2.

Citrus honey yield

Results presented in Table 2 clear that the citrus honey yield harvested from Italian and Carniolan hybrid colonies weighed 8.31and 7.43 kg/ colony in 2014 as well as 9.00 and 9.75 kg/ colony in 2015 season, respectively. Generally, Carniolan and Italian hybrid colonies produced nearly similar citrus honey yield amounted 8.59, 8.65 kg/colony, respectively. In general, 2015 season was more suitable for citrus honey production,

Clover honey yield

Results in Table 2 clear that clover honey yield of Italian and Carniolan hybrid colonies attained 9.12 and 8.81 kg/colony in 2014 and 10.75 and 9.12 kg/colony in 2015 season, respectively.

It is obvious that the prevailing conditions in 2015 were more suitable for clover honey production than those of 2014 season.

It seemed that the meteorological factors were more suitable for both bee foraging and nectar secretion. This statement is in agreement with those of **Lazar (1980) and Nunez (1982)**.

Table 2. Mean citrus and clover honey yield (kg/colony) produced by F_1 Italian and F_1 Carniolan hybrid colonies during 2014 and 2015 seasons

Honeybee race	Citrus honey yield (kg/colony)		Mean of two years	Clover honey yield (kg/colony)		Mean of two years
	2014	2015		2014	2015	
Italian hybrid	8.31	9.00	8.65	9.12	10.75	9.93
Carniolan hybrid	7.43	9.75	8.59	8.81	9.12	8.96
Total	15.74	18.75	17.24	17.93	19.87	18.89
T- test	NS	NS	NS	NS	NS	NS

NS: The difference between treatments is Not-significant.

It could be concluded that Carniolan hybrid is more citrus honey producers than Italian one. This statement is greatly supported by those of **Khater (1998), El-Sayed (2006) and Ali (2011)**. They reported superiority of Carniolan bees could be attributed to the rapid build-up of their colonies early in spring that resulted in producing higher population of workers responsible for honey production. This trend was also reported by **Tarakanov (1974) and Zmarlicki (1974)**. Moreover, **Zmarlicki (1974) and Vesely (1976)** found that spring development was 80% better in Carniolan and in hybrid colonies than in Caucasian. During average early nectar flow bees produce 60% more honey than Caucasian bees.

Results of the present work clear also that 2015 season was more suitable for honey production than 2014, especially during citrus flow period perhaps due to the more suitable weather conditions, in addition to the effect of weather factors on the flowering and nectar production (**Brandburgo and Goncalves, 1989**). These findings are in accordance with those of **Lazar (1980), Nunez (1982), Ledgard and Simes (1983), Perez-Pineiro (1986), Abdallah (1999) and Racys (2002)**.

It is also important to report that the test colonies manifest early and intense foraging during spring that led to higher production of honey where the onset of foraging was very early and in higher populations at 7 a.m. This conclusion was also reported by **Tahmasbi *et al.* (2014)**.

In conclusion and in order to gain higher yields of colony products, it is important to rear (invest) healthy and well built colonies with higher population of workers, not to rear higher numbers of weak unprepared colonies to harvest the highest possible production of hive products.

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تأثير نوع فيض الرحيق وهجين النحل على مط الأساسات الشمعية وإنتاج العسل في طوائف نحل العسل

محمد صلاح محمود قاسم – سعد إبراهيم يوسف خليل - سعد محمد على الشكعة – شوقي محمود عبدالله

قسم وقاية النبات – كلية الزراعة – جامعة الزقازيق – مصر

تم إجراء هذا البحث في منحل خاص بمنطقة الملاك، أبو حماد ، محافظة الشرقية، مصر لدراسة تأثير نوع فيض الرحيق وهجين النحل على أداء طوائف نحل العسل للهجينين الإيطالي والكرنيولي في مط الأساسات الشمعية وإنتاج العسل أثناء فترات فيض الرحيق في موسمي الموالح والبرسيم لعامي ٢٠١٤ و٢٠١٥، ويمكن تلخيص النتائج كما يلي: استنادً لمتوسط العامين أظهرت طوائف هجين النحل الإيطالي كفاءة أعلى في مط الأساسات الشمعية أثناء فترة تزهير البرسيم في عامي الدراسة حيث سجلت مساحة ٣٨٢,٥ بوصة مربعة ممطوطة من شمع الأساس مقارنة بمساحة ٣١٥ بوصة مربعة ممطوطة من الأساس الشمعي في طوائف الهجين الكرنيولي، في حين كانت الاختلافات بين طوائف الهجينين غير معنوية لصالح طوائف النحل الكرنيولي أثناء فترة تزهير الموالح، أثبتت طوائف هجين النحل الإيطالي أنها ذات كفاءة إنتاجية أعلى كمنتج لعسل البرسيم عن طوائف نحل العسل من الهجين الكرنيولي حيث أنتجت متوسطًا قدره ٩,٩٣ كجم عسل برسيم/طائفة مقارنةً مع ٨,٩٦ كجم عسل برسيم/طائفة هجين كرنيولي، هذا وقد تساوت تقريباً طوائف الهجينين في إنتاج عسل الموالح حيث سجل ٨,٦٥ و ٨,٥٩ كجم عسل موالح/طائفة من الهجين الإيطالي والكرنيولي على الترتيب.

المحكمون :

١- **أ.د. أحمد محمود أحمد خطـابي** رئيس بحوث متفرغ – معهد بحوث وقاية النباتات – مركز البحوث الزراعية.

٢- **أ.د. علي مرسي سليمان حجاب** أستاذ الحشرات الاقتصادية المتفرغ – كلية الزراعة – جامعة الزقازيق.