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INFLUENCE OF LANGSTROTH HIVE ON THE PRODUCTIVITY OF BROOD AREA, HONEY, CLOVER AND MAIZE POLLEN

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ABSTRACT: The present study was carried out during spring seasons, of 2019 and 2020 at a special apiary in Al-Kom Al-Akhdar, Shebin Al-Kom, Menoufia Governorate, to study modern methods of breeding three different honeybee strains in order to reach the optimal methods for beekeeping by using langstroth hive and its impact on the productivity of brood areas, honey, clover pollen production and maize pollen production. The obtained results indicated that the mean production of brood area (inch^2) for Langstroth hive ranged from 140.08±0.046 (inch^2) for Carniolan honeybee strain to 71.16±0.208 (inch^2) for Italian honeybee strain. There were highly significant differences between Carniolan honeybee strain and both of Local and Italian honeybee strains. In addition, the honey production for Langstroth hive ranged from 4316.67±187.82 gr, to Italian honeybee strain with 2566.67±92.80 gr. Also, there were highly significant differences between Local and both of Carniolan and Italian honeybee strains. The mean production of clover pollen for Langstroth hive ranged from 1280.78±767.38 cm for Italian honeybee strain to 938.33±29.40 cm for Carniolan honeybee strain Langstroth. There were significant differences between three honeybee strains Maize pollen production which ranged from 1594.58±36.67 to 1139.93±148.76 cm for Carniolan and Italian honeybee strains, respectively. But, there were highly significant differences between three honeybee strains.

Keywords: Langstroth, strains, Carniolan, Italian, Local, honeybee.

INTRODUCTION

Phiri *et al.* (2022), mentioned that there was sustained increase in the global production of honey over the study period. This was influenced by the increases in Asia, South America and Africa. The amounts of honey produced in Europe, North America and Oceania remained similar to those of 1961 throughout the period of interest. Honey production per capita increased by 42.9% at the global level, from 188 kg per 1000 population in 1961 to 269 kg per 1000 population in 2017. There was a remarkable decline in Oceania but less so in Africa, Europe and North America. Only Asia and South America had an upward trend in honey production per capita.

Shehata (2016), indicated that there was significant difference between means of sealed brood areas resulted from carniolan hybrid fed on diet B and control colonies, also there was significant difference between means of sealed brood areas resulted from Italian hybrid fed on diet F and control colonies, during the dearth period from Jul. 2015 until Oct. 2015. while, during the flowering period from Nov. 2015 until Feb. 2016, results indicated a significant difference between the mean brood areas in the Italian colonies fed on diet (F) and Carniolan colonies fed on same diet. Also, there was no significant difference between the mean brood areas in the carniolan and Italian colonies which fed on diet (B) and control colonies. Fathy *et al.* (2017), concluded that upper colonies were more active in brood rearing than lower colonies and this due to abundance of stored pollen in upper colonies (2089 sq.in./colony/year) and decline stored pollen in lower colonies

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(1736sq.in./colony/year). Tarpy *et al.* (2021), there were highly significant effects of worker population ($F_{1,480}$=68.2, p<0.0001) and date ($F_{1,480}$=86.3, p<0.0001) with no significant interaction terms. Interestingly, there was also a significant effect of treatment ($F_{1,480}$=7.98, p<0.0005), with Control colonies growing the least, Brood colonies starting stronger (since they were shook into hives with one frame of open brood) but leveling off similar to Control colonies, and BEP packages starting slowly initially but continued positive growth through the end of the experiment.

Shehata (2016), used two hybrids of honey bee (*Apis mellifera*) colonies were, Carniolan and Italian hybrid bee colonies. He noticed that, for the honey yield, the colonies which fed on artificial diet (B) and (F), during dearth period, revealed significant differences in the amount mean of honey yield between them and control colonies by carniolan and Italian honeybee colonies. While, total mean of honey yield in the colonies which feed on artificial diet (B) and (F), revealed no significant differences between them and control colonies during the flowering period (Eucalyptus trees). Smart *et al.* (2016), indicated that there was a strong positive linear relationship between the area of uncultivated forage land surrounding an apiary and annual apiary survival. Similarly, there was a positive, though not statistically significant, relationship between the amount of uncultivated forage land and honey production and annual survival and honey production were significantly positively related. This relationship was primarily driven by the low survival and productivity of colonies at site F.

Taha and AL-Kahtani (2020), obtained that colony performance including foraging activity, storing pollen, brood production, colony growth, and honey production differed and significantly ($p < 0.01$) affected by comb age. Colonies with combs aged 1, 2 and 3-years were significantly ($p < 0.01$) more active in foraging rate in comparison to colonies with combs aged 4-years (66.40, 64.20 and 61.60 workers/ min./colony vs. 59.20 workers/min./colony, respectively). Tsuruda and Page Jr. (2009), indicated that genotype groups (pooled across treatments) differed significantly for pollen load weights, the proportion of their total load weight that was pollen, nectar load weights, and nectar load concentrations. Fathy *et al.* (2017), concluded that the highest rate of gathering pollen observed during May in lower colonies, recorded (432 sq.in./colony) while in upper colonies recorded (519sq.in./colony) in July. Also in June, large amounts of stored pollen were recorded (303 and 251 sq.in./colony) in upper and lowest colonies, respectively. Engel (2020), found that pollen mass varied greatly throughout time and across treatments, with no statistical significance between treatments ($P = 0.100$), nor was there an interaction between treatment and time. There was a great deal of variation among replicate colonies, making it difficult to detect differences. The “Randall” replicate within Urban colonies, the “Armbruster” replicate within Cropland colonies, and the “Jensen” replicate within Native/Semi-native colonies responded differently than other replicate colonies within respective treatments, with consistently lower pollen mass than other colonies, contributing to the difficulty in detecting statistically significant differences. However certain trends in pollen mass were observed. On days of increased pollen collection, Urban colonies consistently displayed higher pollen mass, with pollen masses up to 187.5 g. Cropland colonies seemed to display reduced pollen mass in comparison with the other treatments, with all pollen collections being less than 30.3 g. Lan *et al.* (2021), indicated a significant preference of *A. mellifera* workers for apricot pollen diets over pear pollen diets (number of bees landing, 29.5 - 8.11 and 9.25 - 5.10, $p < 0.001$ and pollen consumption, 0.052 - 0.026 g/day and 0.033 - 0.013 g/day, ($p < 0.05$). Both pollen diets had comparable extraction efficiencies (67.63% for pear pollen and 67.73% for apricot pollen). Caged workers fed different

pollen diets also exhibited similar ovarian development. However, workers fed apricot pollen had significantly larger hypopharyngeal glands than those fed pear pollen.

MATERIALS AND METHODS

The present study was carried out during spring seasons, of 2019 and 2020 at a special apiary in Al-Kom Al-Akhdar, Shebin Al-Kom, Menoufia Governorate, to study modern methods of breeding three different honeybee strains in order to reach the optimal methods for beekeeping by using langstroth hive and its impact on the productivity of brood areas, honey, clover pollen production and maize pollen production.

The honeybee strains in Langstroth hives are:

1. Local (*Apis mellifera lamarkii*);
2. Carniolan (*Apis mellifera carnica*);
3. Italian (*Apis mellifera ligustica*).

Effect of using different honeybee strains on the rate of queen laying eggs and brood production

In this experiment, three colonies of each langstroth was used for each honeybee strain of Carniolan, Italian and Local to compare the effect of strains on brood areas.

The effect of using different strains on honey and pollen production

In this experiment, three colonies of each langstroth were used for each honeybee strain of Carniolan, Italian and Local to compare the effect of strains on colonies production of honey and pollen.

Statistical analysis

Data were computerized and analyzed according to the following model by SPSS Program (2004).

Also significant differences among means were detected by Duncan (1955).

$$Y_i = \mu + S_i + e_i$$

Where:

Y_i : Observation of i honeybee strain /hives;

μ : General mean;

S_i : Fixed effect of honeybee strain /hives;

e_i : Residual effect.

RESULTS

1. Effect of langstroth hives on brood area, honey, clover pollen and maize pollen for three strains

Table (1) and Figs. (1, 2, 3 and 4) showed that the mean of four production under conditional rearing in langstroth hive for different strains (Carniolan, Italian and Local). The mean production of brood area (inch^2) was 140.08±0.046 inch^2/colony for Carniolan strain followed by 99.76±0.092 inch^2/colony for Local hive, and 71.16±0.208 inch^2/colony for Italian strain. There were highly significant differences between Carniolan strain and both of Local and Italian strains.

With the same results in honey production for Local strain was 4316.67±187.82 gr/colony, followed by Carniolan strain with 3666.67±235.11 gr/colony, and Italian strain with 2566.67±92.80 gr/colony. Also, there were highly significant differences between Local and both of Carniolan and Italian strains.

From the results mentioned that the mean production of clover pollen was 1280.78±767.38 cm/colony for Italian strain, followed by 1231.35±303.28 cm/colony for Local strain and 938.33±29.40 cm/colony for Carniolan strain. There were non significant differences between three strains in clover pollen compared with maize pollen production which was 1594.58±36.67, 1282.97±127.93 and 1139.93±148.76 cm/colony for Carniolan, Local and Italian strains, respectively. But, there were highly significant differences between three strains in maize pollen collected.

Table (1): Mean production of brood area (inch^2), honey, clover pollen and maize pollen under rearing conditional in langstroth hive for different strains.

Strains	Brood area, inch^2.	Honey production, g.	Clover pollen production, cm.	Maize pollen production, cm.
Carniolan	140.08±0.046^a	3666.67±235.11^b	938.33±29.40	1594.58±36.67^a
Italian	71.16±0.208^c	2566.67±92.80^c	1280.78±767.38	1139.93±148.76^b
Local	99.76±0.092^b	4316.67±187.82^a	1231.35±303.28	1282.97±127.93^{ab}
Variance analysis.				
F value	66772.54	23.67227	0.150778	4.06952
Probability	0.000**	0.001**	0.863N.S.	0.046*

a, b, c, :Means in the same column bearing different superscripts are significantly different.
N.S. non significant differences.

* significant differences at P $\leq$ 0.05.

** significant differences at P $\leq$ 0.01.

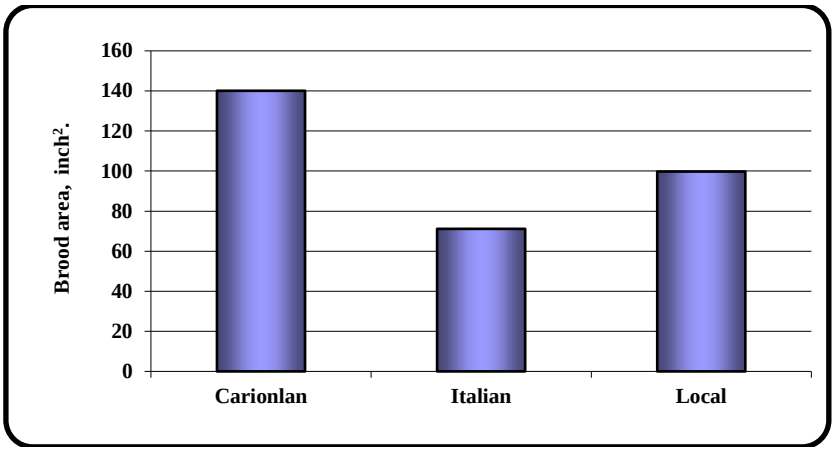

Figure (1): Brood area (inch^2) under conditional rearing of langstroth hive for three strains.

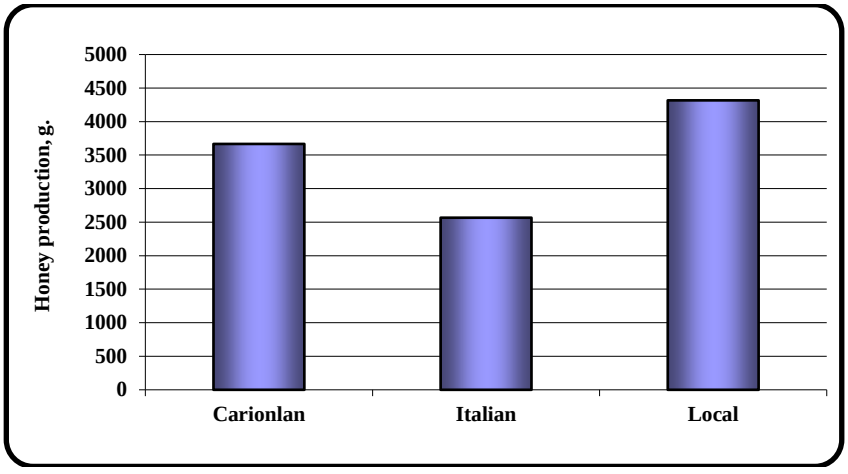

Figure (2): Honey production (g) under conditional rearing of langstroth hive for three strains.

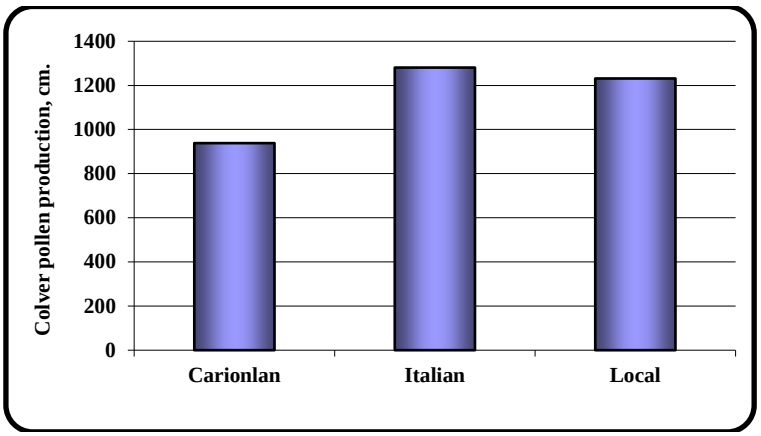

Figure (3): Clover pollen production (cm) under conditional rearing of langstroth hive for three strains.

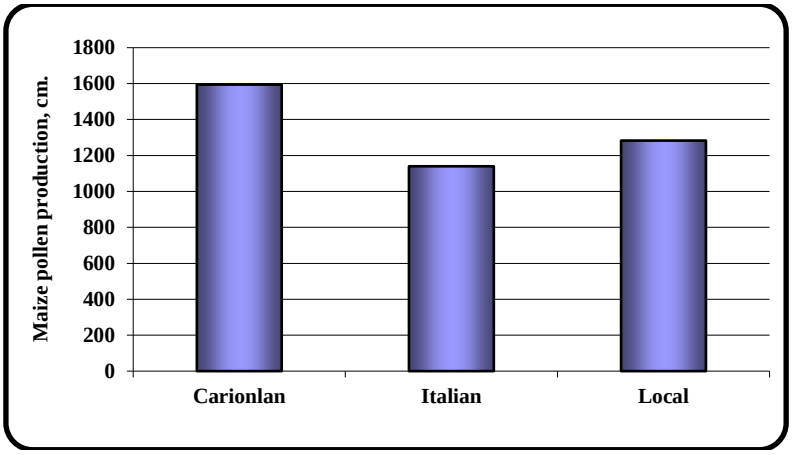

Figure (4): Maize pollen production (cm) under conditional rearing of langstroth hive for three strains.

CONCLUSION

The obtained results could be recommended the use of Local strain to approach the maximum honey production, whereas, the use of Carniolan or Italian strains approach the maximum pollen production.

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تأثير خلية لانجستروث علي الحضنة والعسل وحبوب اللقاح للبرسيم والذرة

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الملخص العربى

أجريت الدراسة الحالية خلال فصلي الربيع لموسمي 2019 ، 2020 بمنحل خاص بمنطقة الكوم الأخضر بشبين الكوم بمحافظة المنوفية لدراسة الأساليب الحديثة لتربية ثلاثة طوائف نحل العسل للوصول إلى الأساليب المثلى لتربية النحل باستخدام خلايا لانجستروث ومدى تأثيرها على إنتاجية الحضنة ، إنتاج العسل وكمية حبوب اللقاح من كل من البرسيم والذرة.

وقد أظهرت الدراسة أن:

1. متوسط إنتاج الحضنة (بوصة^2) لخلية لانجستروث كان 140.08 ± 0.046 بوصة^2 لسلالة النحل الكرنيولي بينما كان 71.16 ± 0.208 بوصة^2 فقط للسلالة الإيطالية ، وكانت هناك فروق معنوية بين السلالة الكرنيولي والسلالة المحلية والسلالة الإيطالية
2. متوسط إنتاج العسل لخلية لانجستروث كان 4316.67 ± 187.82 جم، بينما كان 2566.67 ± 92.80 جم فقط فى السلالة الإيطالية ، وكانت هناك فروق عالية المعنوية بين السلالة المحلية وكلا من السلالة الكرنيولي والسلالة الإيطالية
3. متوسط إنتاج حبوب لقاح البرسيم لخلية لانجستروث كان 1280.78 ± 767.38 سم2 للسلالة الإيطالية، فى حين سجل 938.33 ± 29.40 سم2 للسلالة الكرنيولي ، لم تكن هناك فروق معنوية.
4. متوسط إنتاج حبوب لقاح الذرة كان 1594.58 ± 36.67 سم 2 ، بينما كان 1139.93 ± 148.76 سم2 للسلالة الكرنيولي والسلالة الإيطالية على التوالي، وكانت هناك فروق عالية المعنوية بين السلالات الثلاثة تحت الدراسة .