J. Agric. Sci. Mansoura Univ., 28(8): 6407 - 6417, 2003

# SOME ENVIRONMENTAL FACTORS AFFECTING THE QUALITY OF ARTIFICIALLY REARED QUEENS, (*APIS MELLIFERA* L.) IN NORTH SINAI REGION, EGYPT

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## ABSTRACT

Queen rearing was conducted under North Sinai conditions to determine the effect of some environmental factors on certain biological and biometrical characters of the produced queens during two successive years. The highest percentages of acceptance, sealed queen cells, emerged queens and largest queen cell dimensions as well as heaviest queens with large abdomen diameter were obtained when the queen rearing colonies provided, in continuous, with yeast cake fortified with pollen or sucrose. The semi -dry date fruits (agwa) and carrot"s jam attained moderate values for the above characters, while offered the store honey combs, only, gave the lowest results. The strong queen rearing colonies which contained ten combs covered with bees succeeded those colonies contained worker populations covered either seven or five combs for the forementioned characters. Better virgin queens could be reared successfully during summer (late June), spring (late March) and autumn (October) under prevailing conditions of North Sinai region. Low quality queens was produced during winter season.

## INTRODUCTION

The economic characteristics of the honeybee colony are dependent mainly on the quality of its queen. The queen quality, in turn, depends on both genetic and environmental factors, (Hoopingarner & Farrar, 1959).The rearing conditions that offered by nursery colonies are the most important requirement among the ecological factors to obtain good queens, (Johansson & Johansson, 1973).

Rearing conditions are greatly influenced by colony population, rearing season, kind and quality of the available stores to feed queen larvae. Taber,(1981), reported that 500 young nurse workers were sufficient to raise a good queen. Zhu, (1981), also, found that one comb covered with bees was necessary to raise 2-3 queen cells. On the other hand, Ali, (1994) obtained the maximum yield of royal jelly from strong colonies contained ten combs covered with bees, followed by those contained seven covered combs The most critical factor in the continuous queen rearing is the quantity store of proteinous food, especially pollen, within rearing colony, (Taber, 1976). Many authors suggested that providing honeybee colonies during dearth or the on set of spring with yeast alone or mixed with sugar syrup, cakes of soya bean flour fortified with pollen or any pollen supplements increased the egg laying rate, colony population, number of accepted larvae and emerged

queen as well as the collection of nectar and pollen, (Laidlaw, 1975; Leonard & Darchen, 1978; Szymas & Torgowski, 1980; El-Banby & El-Shreif, 1987 a & b and Ali, 1994). The production and quality of queens are affected, also, by rearing season. Diab, (1986), and Ali, (1994) found that the highest rate of acceptance was obtained during summer, while Sharaf El-Din, (2000) recorded an increase larval acceptance during spring than summer season.

The aim of this work is to study the effects of colony population, providing rearing colonies with pollen supplements and rearing season on some biological and biometrical characters of reared queens under North Sinai conditions.

## MATERIALS AND METHODES

Experiments were undertaken at the apiary of honeybee research center, Faculty of Environmental and Agricultural Sciences at Al- Arish, North Sinai, throughout two successive years, 2000 & 2001. 30 artificial wax cups, each was grafted with about 24 h. old larval floating on a small droplet of 50 % aqueous solution of royal jelly, were fixed on two bars of each grafting frame before introducing into queenless, first hybrid carniolan queen rearing colony. Sugar syrup of approximately 66 % concentration was provided daily during the period of queen rearing.

**Biological and biometrical characters :**

The numbers and percentages of accepted larvae, sealed queen cells and emerged queens were recorded. Each virgin queen was weighed within 4-5 hours after emergence using electrical balance to the nearest 0.01 gram. The dimensions of each queen cell, (depth, width and volume in cm.) and abdomen diameter of emerged queen were measured. Data were analyzed by F test and the means were compared according to L.S.D. test.

**Experiment 1 :**

Fifteen queeniess rearing colonies were divided into equal five groups. Each colony received frame of thirty grafted larvae one day after removed the origin queen and all young brood. Five types of pollen supplementry food, each was provided to colonies of one group. These pollen supplements were :

1- Stored honey combs (control colonies)
2- Carrot"s jam : with 25 gram / colony
3- Semi- dry date fruits (Agwa): it prepared by 25 gram/colony on the top of combs.
4- Sucrose yeast cake: it prepared according to El- Banby and El-Sherif, (1987 a & b ) , and provide by 100 gram / colony.
5- Yeast cake fortified with pollen : the above supplement fortified with pollen collected from trees of *Acacia saligna* and *phoenix dactilefe* by the workers of honeybees.

**Experiment 2 :**

Nine queen rearing colonies were divided into three equal groups according to the worker population as follows :

1- The first group had 5 combs covered with workers in each colony.
2- The second group consisted of seven combs covered with workers in each colony.
3- In the third group, each colony contained honeybee workers covered ten wax combs, (strong colonies).

**Experiment 3 :**

Twelve similar honeybee colonies divided into four equal groups used for raising queens during different seasons of the year. The first group were tested during spring season, (late March), the second group tested during summer, (late June), the third was during autumn, (October) and the fourth during winter, (late December). It is noteworthy that each of the preceding experiments was repeated two times throughout two successive years.

## RESULTS AND DISCUSSION

**1- Effect of different food types on queen rearing**

Data in Table (1) show the mean numbers and percentages of larvae acceptance, sealing queen cells, emerged queens, virgin queen weight, diameter of queen abdomen and various measurements of queen cells as affected by the type of the supplementary food which provided to queen rearing colonies during two successive years, (2000 & 2001).

**A- Effect on larval acceptance, sealing cells and queen emergence**

Results presented in Table (1) revealed that there were significant differences between the various in types of supplementary food and for larvae acceptance, sealing cells and queen emergence. Yeast cake fortified with pollen attained the highest rate of larval acceptance (90.55 %), followed by sucrose yeast cake, (83.33 %) as means of the two successive years. Intermediate results were recorded (53.88 %) using semi-dry date fruits (agwa). Unsatisfied results of acceptance percentages were obtained when the carrot"s jam or combs of stored honey were used as pollen supplements. These percentages were 49.99 % and 38.89 %, respectively. The same trend was appeared for sealed cells and emerged queens percentages throughout the two years of study as affected by the kind of food supplement. The mean percentages of sealed cells and emerged queens were (87.2 % & 83.9 %), (80.5 % & 77.2 %), (50.6 % & 47.2 %), (46.7 % & 43.3. %) and (35.6 % & 32.8 %) for yeast cake fortified with polien, sucrose yeast cake, agwa, carrot's jam and stored honey combs, respectively, Fig (1). It could be concluded from the above results that nursery colonies provided with both yeast cake fortified with pollen or sucrose yeast cake as pollen supplements will significantly increase the acceptance of grafted larvae, sealing cells and queen emergence during commercial queen rearing programme. These results confirmed by Standifer, *et. al., (*1973) and El-Banby & El-Sherif, (1987), where they study that yeast fortified with different ratios of pollen activated the hypopharyngeal glands of nurse workers to accept, care and feed the grafted larvae.

Table (1) Effect of food type on some biometrical characters of virgin queens reared during two successive years in North Sinai

| Feature | | Yeast cake fortified with pollen | | | Sucrose yeast cake | | | Semi-dry date fruits (Agwa) | | | Carrot"s Jam | | | Stored honey combs (Control) | | | L.S.D value at 5% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2000 | 2001 | Mean | 2000 | 2001 | Mean | 2000 | 2001 | Mean | 2000 | 2001 | Mean | 2000 | 2001 | Mean | |
| Queen cell acceptance | Mean | 27.3 | 27.0 | 27.2 | 25.3 | 25.0 | 25.2 | 16.3 | 16.0 | 16.2 | 14.7 | 15.3 | 15.0 | 12.0 | 11.3 | 11.7 | |
| | ±SE | 0.33 | 0.58 | 0.16 | 0.33 | 0.58 | 0.16 | 0.33 | 0.56 | 0.52 | 0.33 | 0.33 | 0.33 | 0.58 | 0.88 | 0.33 | 0.681 |
| | % | 91.1 | 90.0 | 90.6 a | 84.4 | 83.3 | 83.9 b | 54.4 | 53.3 | 53.9 c | 48.9 | 51.1 | 50.0 d | 40.0 | 37.8 | 38.9 e | |
| Sealed queen cells | Mean | 26.3 | 26.0 | 26.2 | 24.3 | 24.0 | 24.2 | 15.3 | 15.0 | 15.2 | 13.7 | 14.3 | 14.0 | 11.0 | 10.3 | 10.7 | |
| | ±SE | 0.33 | 0.58 | 0.16 | 0.33 | 0.58 | 0.16 | 0.33 | 0.58 | 0.16 | 0.33 | 0.33 | 0.33 | 0.58 | 0.88 | 0.33 | 0.681 |
| | % | 87.8 | 86.7 | 87.2 a | 81.1 | 80.0 | 80.6 b | 51.1 | 50.0 | 50.6 c | 45.5 | 47.8 | 46.7 d | 36.8 | 34.4 | 35.6 e | |
| Emerged queens | Mean | 25.3 | 25.0 | 25.2 | 23.3 | 23.0 | 23.2 | 14.3 | 14.0 | 14.2 | 12.7 | 13.3 | 13.0 | 10.0 | 9.7 | 9.8 | |
| | ±SE | 0.33 | 0.58 | 0.16 | 0.33 | 0.58 | 0.16 | 0.33 | 0.58 | 0.16 | 0.33 | 0.33 | 0.33 | 0.58 | 0.66 | 0.17 | 0.637 |
| | % | 84.4 | 83.3 | 83.9 a | 77.8 | 76.7 | 77.2 b | 47.8 | 46.7 | 47.2 c | 42.2 | 44.3 | 43.3 d | 32.3 | 32.2 | 32.8 e | |
| Depth of queen cells(Cm.) | Mean | 2.05 | 2.11 | 2.08 | 2.04 | 2.00 | 2.02 | 1.97 | 1.95 | 1.96 | 1.94 | 1.95 | 1.95 | 1.93 | 1.93 | 1.93 | |
| | ±SE | 0.14 | 0.01 | 0.05 a | 0.02 | 0.01 | 0.02 b | 0.02 | 0.02 | 0.01 c | 0.02 | 0.02 | 0.01 d | 0.02 | 0.02 | 0.01 c | 0.0216 |
| Width of queen cells (Cm.) | Mean | 1.08 | 1.09 | 1.09 | 1.07 | 1.07 | 1.07 | 1.06 | 1.06 | 1.06 | 1.07 | 1.08 | 1.08 | 1.05 | 1.05 | 1.05 | |
| | ±SE | 0.01 | 0.01 | 0.01 a | 0.01 | 0.01 | 0.01 b | 0.01 | 0.01 | 0.01 cd | 0.01 | 0.01 | 0.01 c | 0.01 | 0.01 | 0.01 d | 0.0101 |
| Volume of queen cells(Cm3.) | Mean | 0.79 | 0.79 | 0.79 | 0.79 | 0.76 | 0.78 | 0.77 | 0.77 | 0.77 | 0.76 | 0.76 | 0.76 | 0.75 | 0.75 | 0.75 | |
| | ±SE | 0.01 | 0.01 | 0.01 a | 0.01 | 0.01 | 0.02 b | 0.01 | 0.01 | 0.02 c | 0.01 | 0.01 | 0.01 ab | 0.01 | 0.01 | 0.01 c | 0.0083 |
| Weight of virgin queen(mg.) | Mean | 186.4 | 180.0 | 183.2 | 171.2 | 171.0 | 171.1 | 143.4 | 143.8 | 143.6 | 142.3 | 139.5 | 140.9 | 125.7 | 125.9 | 125.8 | |
| | ±SE | 0.01 | 0.01 | 0.40 a | 0.01 | 0.01 | 0.08 b | 0.01 | 0.01 | 0.14 c | 0.01 | 0.01 | 0.16 c | 0.01 | 0.01 | 0.01 d | 0.0024 |
| Diameter of queen"s Abdomen(Cm) | Mean | 0.53 | 0.55 | 0.54 | 0.52 | 0.50 | 0.51 | 0.47 | 0.41 | 0.44 | 0.42 | 0.42 | 0.42 | 0.42 | 0.41 | 0.42 | |
| | ±SE | 0.01 | 0.01 | 0.01 a | 0.01 | 0.01 | 0.01 b | 0.01 | 0.01 | 0.01 c | 0.01 | 0.01 | 0.01 d | 0.01 | 0.01 | 0.01 d | 0.011 |

Means in the same row followed by the same letter do not differ significantly according to L.S.D value at 0.05

Fig (1) Effect of food type on the percentages of larvae acceptance, sealing queen cells and queen emergence(mean of two years)

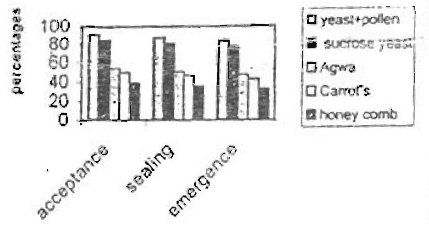



Fig (2) Effect of food type on queen cell dimensions(depth, width and volume) and diameter of queen abdomen, mean of two years)

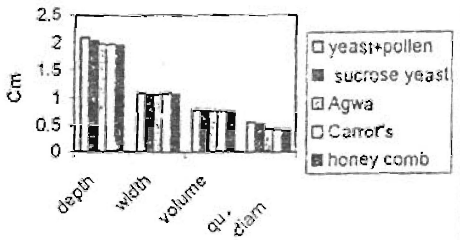
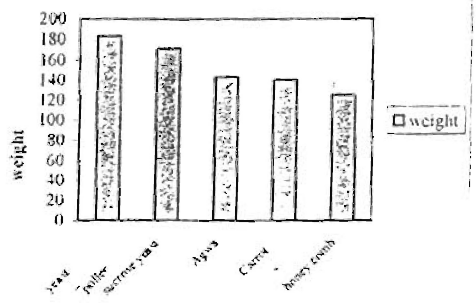



Fig ( 3) Effect of food type on the body weight of newly emerged virgin queens, ( mean of two years).



B- Effect on biometrical characters of queen cells and virgin queens

The mean values of queen cell parameters (depth, width and volume), in addition to weight of virgin queens and its abdominal diameter were significantly exceeded with both yeast fortified with pollen and sucrose yeast than other food types, (Table 1 and Fig. 2& 3 ). On the other hand, no significant differences between agwa and carrot's jam for the depth and volume of queen cells. Therefore queen weight and queen cell parameters were positively correlated and supported by the findings of Kent,(1977) and El-Hanafy,(1991) Ibrahim, (1997) found that the highest mean weight of virgin queens were resulted when colonies provided with yeast cake.

2-Effect of colony population on queen rearing

A- Effect on larval acceptance, sealing cells and queen emergence

Table (2) shows that, the higher percentages of larval acceptance, sealing queen cells and queen emergence were obtained using queen rearing colonies consisted of ten combs covered with bees, (strong colonies), than using seven or five combs covered with bees (moderate colonies or nuclei). Mean acceptance percentage which attained by strong colonies was about two times higher than in nuclei. This may be due to the favorable conditions, specially nest temperature, which offered by crowding colonies than un-crowding ones, (Laidlaw, 1979).

B- Effect on biometrical characters of queen cells and virgin queen

The measurements in Table (2) indicate that the deepest, widest and largest queen cells recorded in strong nursery colonies followed by moderate ones. The mean values were (1.99, 1.09 Cm. & 1.01 Cm.3) and (1.98; 1.09 Cm. and 0.98 Cm.) for the previous parameters in strong and moderate colonies, respectively. Lowest values were recorded by the weak colonies (nuclei). Therefore, heavier queens were emerged from larger size of queen cells as well as the diameter of queen abdomen. These obtained heaviest queens reflect the more attention of workers in strong colonies toward the accepted larvae. They are able to produce the young brood food, royal jelly in large quantities, required for queen rearing. Zhu, (1981) recorded that a colony of ten combs covered with bees could raise from 20- 30 queens in one batch. Ali, (1994) attained the maximum amounts of royal jelly from such colonies.

3- Effect of rearing season on queen production

A- Effect on larvae of acceptance, sealing cells and queen emergence.

The data presented in Fig. (4) revealed that the acceptance percentages of grafted larvae fluctuated throughout different seasons of the year. The highest rate of acceptance was occurred during summer, represented 82.8% as mean of the two successive years. Significant differences were found between summer and other seasons. The lowest significant percentage was appeared in winter, (36.1 %). Moderate results for the accepted larvae was noticed during spring, (70.0 %) and autumn, (72.8 %) seasons with no significant differences between them. Likewise, the percentages of sealed queen cells and emerged queens followed the same trend during the different

Table (2) Effect of colony population on some biological and biometrical characters of virgin queen reared during two successive years in North Sinai

| Feature | | Workers Covered 10 combs | | | Workers Covered 7 combs | | | Workers Covered 5 combs | | | L.S.D |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2000 | 2001 | Mean | 2000 | 2001 | Mean | 2000 | 2001 | Mean | |
| Queen cell acceptance | Mean | 26.0 | 27.0 | 26.5 | 21.3 | 21.7 | 21.5 | 14.3 | 14.0 | 14.2 | 0.938 |
| | ±SE | 0.58 | 0.58 | 0.05 | 0.33 | 0.33 | 0.23 | 0.67 | 0.58 | 0.16 | |
| | % | 86.7 | 90.0 | 88.3 a | 71.1 | 72.2 | 71.6 b | 47.8 | 46.7 | 47.2 c | |
| Sealed queen cell | Mean | 25.0 | 26.0 | 25.5 | 20.0 | 20.7 | 20.3 | 13.3 | 13.0 | 13.2 | 0.998 |
| | ±SE | 0.58 | 0.58 | 0.50 | 20.0 | 0.33 | 0.33 | 0.67 | 0.58 | 0.16 | |
| | % | 83.3 | 86.7 | 85.0 a | 0.58 | 68.9 | 67.8 b | 44.4 | 43.3 | 43.9 c | |
| Emerged *virgin* queen | Mean | 24.0 | 25.0 | 24.5 | 66.7 | 19.7 | 19.3 | 12.3 | 12.0 | 12.2 | 0.938 |
| | ±SE | 0.58 | 0.58 | 0.50 | 19.0 | 0.33 | 0.33 | 0.67 | 0.58 | 0.16 | |
| | % | 80.0 | 83.3 | 81.7 a | 0.58 | 65.5 | 64.4 b | 41.1 | 40.0 | 40.6 c | |
| Depth of queen cell (Cm.) | Mean | 1.99 | 1.98 | 1.99 | 63.3 | 1.98 | 1.98 | 1.95 | 1.73 | 1.84 | 0.0323 |
| | ±SE | 0.02 | 0.02 | 0.01 a | 1.97 | 0.02 | 0.01 a | 0.02 | 0.03 | 0.11 b | |
| Width of queen cell (Cm.) | Mean | 1.08 | 1.09 | 1.09 | 0.02 | 1.09 | 1.09 | 1.0 | 1.0 | 1.00 | 0.0138 |
| | ±SE | 0.01 | 0.01 | 0.01 b | 1.09 | 0.01 | 0.01 a | 0.11 | 0.01 | 0.01 b | |
| Volume of queen cell (Cm)3 | Mean | 1.01 | 1.01 | 1.01 | 0.98 | 0.98 | 0.98 | 0.84 | 0.84 | 0.84 | 0.0127 |
| | ±SE | 0.01 | 0.01 | 0.01 a | 0.01 | 0.01 | 0.01 a | 0.01 | 0.01 | 0.01 c | |
| Weight of virgin queen (mg.) | Mean | 176.80 | 177.87 | 177.34 | 154.38 | 156.27 | 155.32 | 147.29 | 147.77 | 147.53 | 0.0031 |
| | ±SE | 0.01 | 0.01 | 0.04 a | 0.01 | 0.52 | 0.01 b | 0.01 | 0.01 | 0.02 c | |
| Diameter of Queen"s abdomen (Cm.) | Mean | 0.50 | 0.55 | 0.53 | 0.49 | 0.01 | 0.51 | 0.45 | 0.45 | 0.45 | 0.0139 |
| | ±SE | 0.01 | 0.01 | 0.01 a | 0.01 | | 0.01 a | 0.01 | 0.01 | 0.01 c | |

Means in the same row followed by the same letters do not differ significantly according to LSD. Value at 0.05

rearing seasons. These rates were 79.4 %, 69.4 % , 66.1 % and 32.8 %, for sealed cells and were 76.8 %, 66.1 %, 62.2 % and 31.1 % for emerged queens throughout summer,autumn, spring and winter seasons, respectively.

The better results obtained during summer, (late June) may be attributed to suitable weather conditions, specially the ambient temperature, beside blooming many plant species such as, talh, (*Acacia saligna*.), various vegetables and medicinal and ornamental plants which provided colonies with surplus of food, particularly pollen. On the other hand, low ambient temperature negatively affected larval acceptance and queen emergence because the nurse workers probably unable to maintain sufficiently high temperature required to complete queen development within sealed cells. Eskov & Toroptsov, (1979) mentioned that 33 - 34 °C. are optimum temperature for queen production with high quality. Krol, (1985) reported that, during his work on queen rearing, the best time of the year was in May until August.

**B- Effect on biometrical characters of queen cells and virgin queens**

Fig. (5) shows that dimensions of the queen cells, (depth, width and volume) were increased when queens reared during spring, summer and autumn seasons. These figures were, (1.99 Cm., 1.08 Cm. and 1.01 Cm.3) in spring, (2.0 Cm., 1.09 Cm. and 1.02 Cm.3) during summer and(1.97 Cm., 1.01 Cm. and 0.98 Cm.3) for the previous parameters, respectively. These parameters were during autumn. However, the above dimensions were significantly less, (1.74 Cm., 1.00 and 0.84 Cm.3), when the production of queen cells was applied during winter season. Regarding to the body weight of virgin queens and their abdomen diameter, the presented results in Fig. (6) indicate that the heaviest queens with the largest abdomen diameters were emerged from queen cells with the largest dimensions. Therefore, the best queens were obtained during summer (156.9 mg. & 0.50 Cm.), spring (156.72 mg. & 0.53 Cm.) and autumn (154.9 mg. & 0.50 Cm.) seasons under North Sinai conditions. These results may be due to the prevailing suitable conditions in this region throughout a long period of the year. These conditions including both weather factors and available of food sources which positively reflected on the living conditions in the colony. Colony reaction was appeared in the amounts of royal jelly secreted and provided to queen larvae by the nurse workers, resulting heavy queens. This conclusion was in agreement with the findings of Krol, (1985), who reported that the best time of the year for queen production, in north Europe, was from May until August. Ali, (1994) obtained the highest acceptance percentage and quantity of royal jelly during summer, then spring and autumn seasons, while the lowest amounts were recorded during winter season.

Fig ( 4 ) Effect of rearing season on the percentages of larvae acceptance, sealing queen cells and queen emergence (mean of two years)

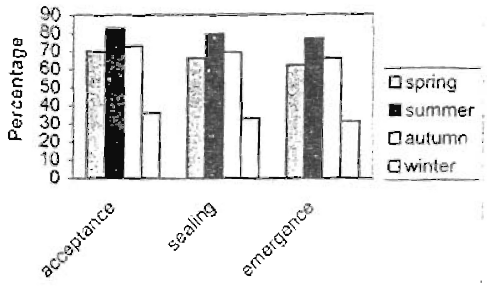



Fig ( 5 ) Effect of rearing season on the diminsions of queen cell, (depth, width and volume) and the diameter of queen abdomen ( mean of two years)

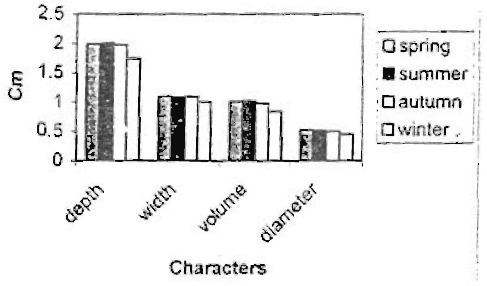
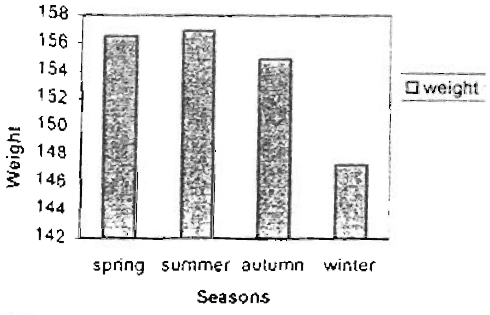



Fig ( ) Effect of rearing season on the body weight of newly emerged virgin queens (mean of two years ).



## ACKNOWLEDGMENT

Deep gratitude to Dr. M. A. Eid Prof. of Economic Entomology and Pesticides Fac. Agric., Cairo Univ. for his advise and reviewing this manuscript.

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## بعض العوامل البيئية المؤثرة في جودة الملكات المرباة صناعيا في منطقة جنوب سيناء, مصر

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*جامعة القاهرة – قسم الحشرات الاقتصادية و المبيدات – كلية الزراعة

** جامعة قناة السويس -كلية العلوم الزراعية البيئية بالعريش -قسم الإنتاج النباتي ووقايته

أجرى هذا البحث في منحل كلية العلوم الزراعية البيئية بالعريش لدراسة بعض الصفات البيولوجية و البيومترية للبيوت الملكية و الملكات المرباة تحت تأثيرظروف بيئة معينة (نوع الغذاء البروتيني المدعم للتربية , قوة طائفة التربية و موسم التربية ) و كرر هذا العمل مرتين خلال عامى ٢٠٠٠ و ٢٠٠١.

و يمكن تلخيص النتائج فيما يلي:-

١- تأثير نوع الغذاء المدعم:-

أظهرت النتائج أن الطوائف التي غذيت على عجينه الخميرة البيرة المدعمة بحبوب لقاح النخيل و لأكاسيا أحرزت أعلى نسبة من قبول اليرقات المطعومة و ختم البيوت الملكية ,و نفس الملكات .و كذلك بالنسبة للقياسات الخاصة بمواصفات البيوت الملكية و الملكات العذارى الناتجة ثم تلى ذلك الطوائف المغذاة على عجينه الخميرة بالسكر فقط تم العجوة و مربى الجزر بينما لم تحقق الطوائف المقدم لها أقراص عسلية فقط نتائج مشجعة.

٢- تأثير قوة طائفة التربية:-

لوحظ زيادة القيم الناتجة بالنسبة للقياسات السابقة بزيادة قوة الطائفة حيث حققت الطوائف المحتوية على عشرة أقراص مغطاة بالنحل أفضل النتائج ثم تلك المحتوية على سبعة أقراص مغطاة بالنحل و أخيرا الذريات المحتوية على خمسة أقراص مغطاة بالنحل .مما يدفع إلى تقوية الطوائف جيدا عند الرغبة في إنتاج ملكات جيدة .

٣- تأثير موسم التربية

أظهرت النتائج إمكانية تربية و إنتاج الملكات العذارى في أي فصل من العام تحت الظروف البيئية لمنطقة شمال سيناء. ولكن أفضل النتائج تم الحصول عليها خلال فصل الصيف ثم الربيع ثم الخريف و أخيرا فصل الشتاء بالنسبة لصفات القبول و ختم البيوت الملكية و خروج الملكات وكذلك أوزان الملكات الناتجة.