

## EFFECT OF THYROXINE AND MELATONIN AND INSECT GROWTH REGULATOR, IKI ON HONEYBEE ACTIVITIES

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### ABSTRACT

The present investigation was conducted at the apiary of Beekeeping Research Section at Sakha Agricultural Research Station, Kafr El-Sheikh Governorate from September, 2007 until April, 2008. The objective was to find out the effect of mixing some supplements to the sugar syrup, offered to feeding the colonies, on honeybee activities and honey yield. The results indicated that the total number of workers foraging in treatments of thyroxine  $1.6 \times 10^{-7}$  M + melatonin 1.2%, thyroxine  $1.6 \times 10^{-7}$  M, melatonin 1.2% and melatonin 1.2% + IKI 10 ppm were 128.00, 116.28, 104.79 and 98.85 workers/colony/minute, respectively. IKI 10 ppm and control treatments induced the lowest total number of workers foraging (76.10 and 78.85 worker/colony/minute, respectively). Increase percentages of brood rearing areas over the control were in treatment of thyroxine + melatonin (44.02%), thyroxine (36.79), melatonin (30.11) and melatonin + IKI (27.28 inch<sup>2</sup>/colony). The lowest one was that of IKI treatment (-1.96 inch<sup>2</sup>/colony). The lowest monthly average of stored pollen was recorded during November, 2007 in colonies fed on thyroxine + melatonin, thyroxine, melatonin, melatonin + IKI, IKI and control, with values of 37.40, 35.20, 33.20, 30.10, 25.20 and 26.40 inch<sup>2</sup>/colony, respectively. The highest monthly averages of stored pollen area were recorded during March, 2008 for the same previous treatments recording 220.23, 210.80, 195.50, 190.50, 166.56 and 170.85 inch<sup>2</sup>/colony, respectively. Data proved that thyroxine + melatonin treatment gave the highest average of workers incoming with pollen followed by thyroxine, melatonin, then control, while IKI treatment recorded the lowest average. No significant differences in honey yield were found among colonies fed on thyroxine, melatonin and melatonin + IKI treatments.

Only the treatment of thyroxine + melatonin overpassed the other treatments, which could be recommended to enhance the honeybee activities and honey yield.

### INTRODUCTION

Honeybee, *Apis mellifera* L. is a very important beneficial insect due to its role in the pollination of flowering plants. The main product of honeybee is honey beside the pollen, royal jelly, wax, propolis and bee venom. Numbers of apiaries, in Egypt, are going to increase, which reflect overcrowding of honeybee colonies. This high density was considered as a main factor in reducing production of honey and other products (Mansour *et al.*, 2003). The total number of colonies is approximately 79,000 but the mean produced honey per colony decreased to 5.42 kg/colony (Sherif, 2003). Beekeepers are always looking for information about the major or minor food sources in their areas. The knowledge about the available sources are needed to successfully manage the bees. On the other hand, beekeepers work hard to maximize their benefits from beekeeping by moving their colonies to new locations having good sources of pollen and nectar. Other beekeepers add to the sugar syrup one are more of materials rich in proteins,

vitamins, carbohydrates and antibiotics to motivate different activities of honeybee colonies. Addition of lemon and orange juices to the sugar syrup amis to increase the syrup consumption, brood rearing and honey yield (Hussein and Omer, 1989 and Gomaa, 2004). Thyroxine, hormone secreted by thyroid gland, increases the number and activity of mitochondria in cells by binding to the cells DNA, increasing the basal metabolic rate. Also, it causes an increase in rate of carbohydrate metabolism and a rise in the rate of protein synthesis and breakdown (Oppenheimer and Trvernetti, 2005). Melatonin is a hormone produced by the pineal gland located in the exact center of the brain. It increases total sleep time and stimulates number of immune cells (Wade *et al.*, 2007). Gomaa (2004) found that using the melatonin at a concentration of 1.2% in feeding the honeybee colonies enhances foraging activity than control. Insect growth regulators (IGRs) referred to as "third generation pesticides" are a diverse group of insecticides that disrupt the development of insects. IGRs (IKI 7899) can be divided into two major groups based on their mode of action, juvenile analogues and chitin synthesis. Saad (1996) found that using the insect growth regulator IKI at a concentration of 0.5 ppm during last larval instar increased the larval weight of the non-mulberry silkworm, *Philosomia ricini* (Boisd.) without dead or deformed larvae.

The current study was carried out to investigate the effect of three treatments (Thyroxine 776.96, Melatonin and IKI 7899) on some honeybee parameters; foraging honeybee workers, stored pollen, brood rearing activities, incoming honeybee workers with pollen and honey yield.

## **MATERIALS AND METHODS**

This experiment was carried out at the apiary of Beekeeping Research Section at Sakha Agricultural Research Station, Kafr El-Sheikh Governorate from September, 2007 until April, 2008.

Eighteen colonies of first hybrid carniolan bees were assigned and divided into six groups, three colonies each. Thus, the investigation had three replicates/treatment. All the honeybee colonies were approximately equal in strength and in number of combs covered with bees and had sufficient food. Colonies were headed with newly and naturally mated queens.

The experiments were conducted to find out the effect of some supplements mixed with the sugar syrup to increase honeybee activities during autumn, winter and spring seasons, as a trial to avoid moving honeybee colonies searching for sufficient sources of nectar and pollen.

### **Treatments:**

Each of the following supplements were mixed with the standard sugar solution offered for feeding the colonies every five days:

- a. Thyroxine (M.W: 776.93) an iodine-containing hormone  $C_{15}H_{11}I_4NO_4$  that is an amino acid produced by the thyroid gland. Stock solution of thyroxine was prepared by dissolving 25 mg Thyroxine (thyroxine, M.W 776.93) in 100 ml 0.1 M NaOH, then the solution made up to 1 L. with distilled water. This solution was stored in the dark at 4°C for no more

than one month. Stock solution of thyroxine 5 ml was diluted to 1 L. with distilled sugar solution to give  $1.6 \times 10^{-7}$  M. In this treatment, thyroxine was used a solution at concentration 5 ml/1 L. to give  $1.6 \times 10^{-7}$  M.

- b. Melatonin: (N, Acetyl-5 Methoxy tryptomen) 3 mg, and vitamin B<sub>6</sub> (Pyroxen hydrochloride) 10 mg in one capsule used at a concentration 1.2% as powder.
- c. IKI-7899 insect growth regulation (IGRs) as antimoulting hormones: (Atabron or IKI-7899-R<sub>5</sub> % E.C) N-(2,6-difluorobenzoyl)-N-(3,5-dichloro-4-(3-chloro-s-trifluoromethyl-2-pyridyloxy) phenylurea. IKI in this study was used at a concentration 100 ppm.
- d. Mixture from thyroxine 776.93 at a concentration  $1.6 \times 10^{-7}$  M + melatonin 1.2%.
- e. Mixture from melatonin 1.2% + IKI 7899 at 100 ppm.
- f. Control: addition 2 kg sugar to 1 L. water and feeding the colonies with sugar syrup alone every five days.

## **2. Honeybee activities.**

### **a. Foraging:**

Foraging activity of honeybee workers was estimated by counting the workers flying out and workers returning into the colonies during one minute. The counts were carried out three days a week and four times a day at 10, 12 am. and 2, 4 p.m.

### **b. Brood rearing:**

The number of sealed brood areas of workers per square inch was measured every 12 days using a standard frame divided into square inches by nylon threads according to Nolan (1925) and Allen and Jeffree (1956).

### **c. Stored pollen:**

Areas of stored pollen were measured by the same manner for brood area.

### **d. Incoming honeybee workers with pollen:**

Incoming honeybee workers were estimated by counting the works returning with pollen into the colonies within one minute. The counts were carried out twelve days a month, three days a week and four times a day at 10, 12 a.m. and 2, 4 p.m.

### **e. Honey yield:**

Weight of the obtained honey yield (in kg) of clover honey was calculated as the difference between the weight of honey combs before and after extraction.

## **RESULTS AND DISCUSSION**

### **1. Effect of some supplements mixed with sugar syrup on some parameters of honeybee activities:**

#### **1.a. Foraging workers:**

The results showed that monthly average of foraging honeybee workers during September, 2007 in treatments of thyroxine  $1.6 \times 10^{-7}$  M + melatonin 1.2%, Thyroxine  $1.6 \times 10^{-7}$  M + melatonin 1.2% and melatonin 1.2% + IKI 10 ppm were 16.95, 15.50, 14.35 and 12.25 worker/colony/minute, respectively,

while, IKI 10 ppm and control were 10.00 and 9.51 worker/colony/minute, respectively. Number foragers decreased during October and November 2007 in colonies fed on thyroxine  $1.6 \times 10^{-7}$  M + melatonin 1.2%, thyroxine  $1.6 \times 10^{-7}$  M, melatonin 1.2%, melatonin 1.2% + IKI 10 ppm, IKI 10 ppm and control (12.85 & 12.60), (11.45 & 11.60), (10.00 & 10.31), (9.65 & 10.00), (6.20 & 7.00) (7.00 & 7.45 worker/colony/minute), respectively. Another increase in foraging activity appeared in March and April, 2008 as recorded (18.70 & 26.50), (16.75 & 23.50), (14.85 & 21.45), (13.75 & 20.00), (10.85 & 14.00) and (12.33 & 15.36 worker/colony/minute, for thyroxine + melatonin, thyroxine, melatonin, melatonin + IKI, IKI and control, respectively. Also, data in Table (1) showed that the total number of foragers in treatments of thyroxine + melatonin, thyroxine, melatonin and melatonin + IKI during the previous period were 128.00, 116.28, 104.79 and 98.85 worker/colony/minute, respectively. IKI and control treatments recorded the lowest total number of foragers during the same period (76.10 and 78.85 worker/ colony/minute, respectively).

**Table (1): Monthly average of foraging honeybee workers/minute in colonies fed on some additives supplemented to sugar syrup.**

Month	Treatment					Control	Temp.
	Thyroxine $1.6 \times 10^{-7}$ M	Melatonin 1.2%	IKI 10 ppm	Thyroxine $1.6 \times 10^{-7}$ M + Melatonin 1.2%	Melatonin 1.2%+IKI 10 ppm		
Sept. 2007	15.50	14.35	10.00	16.95	12.25	9.51	32.0
Oct.	11.45	10.00	6.20	12.85	9.65	7.00	29.2
Nov	11.60	10.31	7.00	12.60	10.00	7.45	26.0
Dec.	11.75	10.50	9.00	12.65	11.15	7.55	21.0
Jan. 2008	12.10	11.00	9.05	13.00	10.20	9.50	18.0
Feb.	13.63	12.33	10.00	14.75	11.85	10.15	20.4
Mar.	16.75	14.85	10.85	18.70	13.75	12.33	25.0
Apr.	23.50	21.45	14.00	26.50	20.00	15.36	27.8
Total	116.28	104.79	76.10	128.00	98.85	78.85	-
Average	14.54 c	13.10 b	9.51 a	16.00 d	12.36 b	9.86 a	-
Increase % over control	47.46	32.86	-3.55	62.27	25.35	-	-

Means followed by the same letter are not significantly different at 5% level according Duncan's Multiple Range test.

Statistical analysis showed significant differences among thyroxine + melatonin, thyroxine, melatonin and other treatments and non significant differences between colonies fed on melatonin only, melatonin + IKI and IKI and control. In this concern, Gomaa (2004) indicated that the weekly average number of foragers during the period from 20<sup>th</sup> of April to 24<sup>th</sup> of August increased in treatments of chickpea powder, *Cicer arietinum*, melatonin and IKI 7899 compared to control treatment. The concentration of 7.5% of chickpea was better than 2.5 or 5% concentrations. He also found that melatonin 1.2% was better than melatonin 0.6%. Elekonich *et al.* (2001) found that thyroxine increased the number of foragers, average of egg laying and queen longevity. Sullivan *et al.* (2000) reported that JH. titers in worker

honeybees progressively increase from 15 to 50 days of the worker life before the onset of foraging. During the first 15 days, works perform tasks inside the hive, such as nursing larvae constructing comb, and cleaning cells. Aggressiveness of guard bees is correlated with their blood JH levels. Even though guards have high JH levels, their ovaries are relatively undeveloped. Although JH does not activate foraging, but rather is involved in controlling the pace at which bees develop foragers.

Foraging activity of honeybee colonies depends upon many factors, e.g. weather, population density, abundance of nectar and pollen sources (Szabo, 1980 and Shawer *et al.*, 1986). Addition of materials such as vitamins, growth regulators and pollen supplements to sugar syrup were used in a certain time, to activate the honeybee workers to flight.

**1.b. Brood rearing activity:**

Data in Table (2) showed that the total of brood rearing in treatment of thyroxine + melatonin recorded 316.65 inch<sup>2</sup>/colony, followed by thyroxine as 300.77 inch<sup>2</sup>/colony, but melatonin and melatonin + IKI recorded 286.07 and 279.86 inch<sup>2</sup>/colony, respectively. While, the lowest were those of control and IKI treatments (219.87 and 215.55 inch<sup>2</sup>/colony, respectively). Increases % of brood rearing areas over the control were recorded in treatments of thyroxine + melatonin recorded (44.02), Thyroxine (36.79), melatonin (30.11) and melatonin + IKI (27.28 inch<sup>2</sup>/colony), the lowest one was that of IKI treatment and recorded (-1.96 inch<sup>2</sup>/colony). Statistical analysis showed significant differences among all treatments and control.

**Table (2): Monthly average of brood rearing areas (sq. inch) per colony in colonies fed on some additives supplemented to sugar syrup.**

Month	Treatment					Control	Temp.
	Thyroxine 1.6 x 10 <sup>-7</sup> M	Melatonin 1.2%	IKI 10 ppm	Thyroxine 1.6 x 10 <sup>-7</sup> M + Melatonin 1.2%	Melatonin 1.2%+IKI 10 ppm		
Sept. 2007	455.50	425.30	350.40	505.50	405.35	360.25	30.2
Oct.	199.25	180.00	155.00	208.25	188.25	160.30	29.0
Nov	18.20	16.22	11.35	19.85	16.50	10.00	23.3
Dec.	50.85	47.35	35.20	59.25	45.15	36.40	22.3
Jan. 2008	61.95	59.50	42.50	64.15	58.10	41.13	17.8
Feb.	260.10	240.00	154.15	270.18	235.15	160.20	19.5
Mar.	610.00	595.00	445.70	621.00	585.17	450.40	29.3
Apr.	750.33	725.20	530.10	785.00	705.24	540.25	28.3
Total	2406.18	2288.57	1724.40	2533.18	2238.91	1758.93	-
Average	300.77 e	286.07 d	215.55 a	316.65 f	279.86 c	219.87 b	-
Increase % over control	36.79	30.11	-1.96	44.02	27.28	-	-

In a raw, means followed by the same letter are not significantly different at 5% level according Duncan's Multiple Range

In this concern, Gomaa (2004) indicated that the total of brood rearing area during the period from 9<sup>th</sup> of April to 24<sup>th</sup> of August, 1999 in treatment of melatonin 1.2% recorded 1351.0 sq. inch/colony, followed by chickpea 7.5% as 1271.8 sq inch/colony, but melatonin 1.2% + IKI 10 ppm

induced 1073.5 sq inch/colony, the lowest one was control that recorded 1021.9 sq. inch/colony.

**1.c. Stored pollen:**

Data in Table (3) revealed that the lowest monthly average of stored pollen was recorded in November, 2007 in colonies fed on thyroxine + melatonin, thyroxine, melatonin, melatonin + IKI, IKI and control, 37.40, 35.20, 33.20, 30.10, 25.20 and 26.40 inch<sup>2</sup>/colony, respectively. While, the highest averages were recorded in March, 2008, with the corresponding values of 220.23, 210.80, 195.50, 190.50, 166.56 and 170.85 inch<sup>2</sup>/colony, respectively. The highest total of stored pollen area was detected in colonies fed on thyroxine + melatonin followed by thyroxine, melatonin and melatonin + IKI, recording 893.43, 850.09, 802.78 and 761.19 inch<sup>2</sup>/colony, respectively, but the lowest totals were those of IKI and control recording 658.53 and 661.65 inch<sup>2</sup>/colony, respectively. Also, % increase over control in treatments of thyroxine + melatonin, thyroxine, melatonin and melatonin + IKI were 35.03, 28.47, 21.33 and 15.04 inch<sup>2</sup>/colony, respectively, but IKI treatment recorded percentage decrease of 0.47 inch<sup>2</sup>/colony, respectively. Ismail (2001) obtained significant differences between the volatile oils and control concerning stored pollen. Treated colonies with thyme from January to May were more active in collecting pollen (689.5 sq inch) than treated colonies with rosemary (412.5 sq. inch). These results agree with those of Fathy (1998) who found that colonies treated with thyme during the same period collected more pollen (977 sq inch) than treated colonies with rosemary (957 sq. inch).

**Table (3): Monthly average of stored pollen in sq. inch/colony in colonies fed on some additives supplemented to sugar syrup.**

Month	Treatment					Control	Temp.
	Thyroxine 1.6 x 10 <sup>-7</sup> M	Melatonin 1.2%	IKI 10 ppm	Thyroxine 1.6 x 10 <sup>-7</sup> M + Melatonin 1.2%	Melatonin 1.2%+IKI 10 ppm		
Sept. 2007	150.60	145.15	125.50	153.25	140.25	126.20	30.2
Oct.	40.25	38.17	30.22	43.17	36.40	31.25	29.0
Nov	35.20	33.20	25.20	37.40	30.10	26.40	23.3
Dec.	45.30	43.10	35.15	48.50	35.70	31.60	22.3
Jan. 2008	57.00	53.20	45.80	59.85	47.90	43.95	17.8
Feb.	134.99	129.28	93.88	144.15	120.00	95.00	19.5
Mar.	210.80	195.50	166.56	220.23	190.50	170.85	29.3
Apr.	175.95	165.18	136.22	186.88	160.34	136.40	28.3
Total	850.09	802.78	658.53	893.43	761.19	661.65	-
Average	106.26 d	100.35 c	82.32 a	111.68 d	95.15 b	82.71 a	-
Increase % over control	28.47	21.33	-0.47	35.03	15.04	-	-

Means followed by the same letters are not significantly different at 5% level according Duncan's Multiple Range Test.

**1.d. Incoming workers with pollen:**

Data presented in Table (4) show the monthly average of workers incoming with pollen during the period from September, 2007 to April, 2008. The results indicated that the monthly average of incoming workers with pollen decreased in October, 2007 and recorded 3.95, 3.00, 2.55, 2.45, 1.85 and 2.25 workers/colony/minute in treatments thyroxine + melatonin, thyroxine, melatonin, melatonin + IKI, IKI and control, respectively, but it increased in April, 2008 in all previous treatments; 8.65, 8.13, 7.15, 6.95, 4.10 and 5.00, respectively. Percentage of increase over control in treatments thyroxine + melatonin, thyroxine, melatonin and melatonin + IKI were 64.61, 53.09, 25.56 and 23.88% worker/colony/minute, respectively. While, the IKI treatment recorded a reduction of 22.19 worker/colony/minute compared to control. Statistical analysis revealed significant differences among all treatments in concern with incoming workers. Thus, it could be reported that thyroxine + melatonin treatment gave higher average workers incoming with pollen followed by thyroxin, melatonin, than control while IKI recorded the lowest average number of workers. *Shawer et al. (1985)* recorded a significant positive correlation between colony strength and incoming workers with pollen. *Goyal and Rana (1994)* indicated that the percentage of incoming workers with pollen increased from 58 to 74 one day after feeding colonies with vitamin B and sugar solution. Also, in this concern, *Eweies and Ali (1977)* and *Silva and Silva (1985)*, reported that the addition of ascorbic acid to sugar syrup improved brood rearing ability and incoming workers with pollen.

**Table (4): Monthly average of incoming honeybee workers with pollen/minute in colonies fed on some additives supplemented to sugar syrup.**

Month	Treatments					Control	Temp.
	Thyroxine 1.6 x 10 <sup>-7</sup> M	Melatonin 1.2%	IKI 10 ppm	Thyroxine 1.6 x 10 <sup>-7</sup> M + Melatonin 1.2%	Melatonin 1.2%+IKI 10 ppm		
Sept. 2007	4.95	4.70	2.85	5.11	4.01	3.18	31.2
Oct.	3.00	2.55	1.85	3.95	2.45	2.25	28.5
Nov	3.25	3.00	2.13	3.85	3.03	2.44	25.3
Dec.	4.85	3.99	2.80	4.90	3.75	2.99	19.0
Jan. 2008	5.60	5.00	2.35	5.60	4.77	3.40	18.0
Feb.	5.95	5.00	3.00	6.00	4.11	4.35	23.0
Mar.	7.90	6.35	3.10	8.80	6.20	4.85	26.0
Apr.	8.13	7.15	4.10	8.65	6.95	5.00	28.7
Total	43.63	35.74	22.18	46.86	35.27	28.46	-
Average	5.45 d	4.47 a	2.77 c	5.86 d	4.41 c	3.56 b	-
Increase % over control	53.09	25.56	-22.19	64.61	23.88	-	-

Means followed by the same letters are not significantly different at 5% level according Duncan's Multiple Range

1.e. Honey yield:

The results in Table (5) revealed that colonies fed on thyroxine + melatonin gave the highest amount of honey (5.85 kg per colony), followed by colonies fed on thyroxine, melatonin and melatonin + IKI as gave 5.00, 4.45 and 4.25 kg/colony, respectively, while IKI colonies gave the lowest; 2.81 kg/colony, but the control colonies gave less amount of honey of 3.05 kg/colony. The colonies fed on thyroxine + melatonin, thyroxine, melatonin, and melatonin + IKI revealed that the increases % over the control were 91.80, 63.93, 45.90 and 39.34, respectively. Statistical analysis showed insignificant differences in honey yield between colonies fed on thyroxine, melatonin and melatonin + IKI treatments, but the difference was significant between these previous treatments and thyroxine + melatonin treatment, while non significant difference was found between IKI treatment and control. Feeding colonies is very important to increase the average of honey yield, which agrees with the results of Sckekeladze (1973), Hussein (1983) and Kumova (1999). Fathy and El-Tawila (1998) studied the effect of four compounds (Flumox, flummox + vitamin B<sub>12</sub>, Velosef, Velosef + vitamin B<sub>12</sub>) on honey yield. They found that the colonies treated with flummox + vitamin B<sub>12</sub> gave the highest amount of honey (7.80 kg/colony), while, colonies treated with Velosef alone gave the lowest production of honey (3.90 kg/colony).

From these results, it could be reported that thyroxine + melatonin and thyroxine treatments induced the best honeybee activities followed by melatonin and melatonin + IKI, while, IKI treatment induced lowest activities.

Table (5): Average of honey yield as affected by some additions supplemented to sugar syrup during 2008 season.

Treatments	Honey	
	Yield	Increase%
Thyroxine 1.6 x 10 <sup>-7</sup> M	5.00 b	63.93
Melatonin 1.2%	4.45 b	45.90
IKI 10 ppm	2.814 a	-7.87
Thyroxine 1.6 x 10 <sup>-7</sup> M + Melatonin 1.2%	5.85 c	91.80
Melatonin 1.2% + IKI 10 ppm	4.25 b	39.34
Control	3.05 a	-

In a column, means followed by the same letter are not significantly different according to DMRT at 5% level.

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## كفاءة هرموني الثيروكسين والميلاتونين ومنظم النمو الحشري IKI على أنشطة نحل العسل

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أجريت الدراسة فى قسم بحوث النحل بمحطة البحوث الزراعية بسخا - كفر الشيخ خلال الفترة من سبتمبر ٢٠٠٧ إلى ابريل ٢٠٠٨ على ثمانى عشرة خلية متساوية فى كل من القوة وعدد البراوير وذات ملكات اخوة وكان الهدف هو دراسة تأثير بعض المعاملات مثل الثيروكسين ، الميلاتونين ، الثيروكسين مخلوطا مع الميلاتونين ، الميلاتونين مخلوطا مع IKI و IKI منفردا على: نشاط سروح النحل - مساحات حبوب اللقاح المخزنة - نشاط تربية الحضنة - نشاط الشغالات العائدة الى الخلية محملة بحبوب اللقاح ومحصول العسل.

أظهرت النتائج أن متوسط أعداد الشغالات السارحة فى معاملات الثيروكسين + الميلاتونين ، الثيروكسين ، الميلاتونين ، الميلاتونين + IKI كانت ١٢٨,٠٠ ، ١١٦,٢٨ ، ١٠٤,٧٩ ، ٩٨,٨٥ شغاله/خلية/دقيقة على التوالي بينما سجلت معاملات IKI والمقارنة أقل أعداد من الشغالات السارحة ٦٧,١٠ ، ٧٨,٨٥ شغاله/خلية/دقيقة على التوالي. كما أوضحت النتائج أن نسبة الزيادة فى مساحة تربية الحضنة للمعاملات المختلفة بالنسبة لمعاملة المقارنة كانت فى معاملة الثيروكسين + الميلاتونين (٤٤,٠٢) ، الثيروكسين (٣٦,٧٩) ، الميلاتونين (٣٠,١١) ومعاملة الميلاتونين + IKI (٢٧,٢٨) بوصة مربعة/خلية) على التوالي بينما كانت أقل معاملة عند المقارنة هى IKI حيث سجلت نقصا مقداره ١,٩٦ بوصة مربعة/خلية). سجلت النتائج أيضا أن أقل متوسط حبوب لقاح مخزنة كانت خلال شهر نوفمبر ٢٠٠٧ فى الخلايا التى تمت تغذيتها على الثيروكسين + الميلاتونين ، الثيروكسين ، الميلاتونين ، الميلاتونين + IKI ، IKI والمقارنة وكانت كالتالى: ٣٧,٤٠ ، ٣٥,٢٠ ، ٣٣,٢٠ ، ٣٠,١٠ ، ٢٥,٢٠ ، ٢٦,٤٠ بوصة مربعة/خلية بينما كان أكبر متوسط حبوب لقاح مخزنة خلال شهر مارس ٢٠٠٨ للمعاملات السابقة كالتالى ٢٢٠,٢٣ ، ٢١٠,٨٠ ، ١٩٥,٥٠ ، ١٩٠,٥٠ ، ١٦٦,٥٦ و ١٧٠,٨٥ بوصة مربعة/خلية.

ومن النتائج يمكن التأكيد على أن معاملة الثيروكسين + الميلاتونين أعطت أعلى معدل لعودة الشغالات للمحملة بحبوب اللقاح إلى الخلية مقارنة بمعاملات الثيروكسين ، الميلاتونين والكنترول وكان أقل معدل للشغالات العائدة إلى الخلية محملة بحبوب اللقاح فى معاملة IKI.

أظهرت نتائج التحليل الإحصائى أنه لا توجد اختلافات معنوية فى محصول العسل بين الخلايا التى تمت تغذيتها على الثيروكسين ، الميلاتونين والميلاتونين + IKI بينما كانت هناك اختلافات معنوية بين معاملة الثيروكسين + الميلاتونين والمعاملات الأخرى كما سجل اختلاف معنوى بين معاملتى IKI والكنترول فى محصول العسل.