Minufiya J. Agric. Res. Vol. 32 NO.1: 269 - 281 (2007)

EFFECT OF THE MAGNETIC FIELD ON STAGES THE WHITEFLY, *BEMISIA TABACI* GENNODIUS (HOMOPTERA : ALEYRODIDAE)

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(Received: Dec. 18, 2006)

ABSTRACT: ***This study was carried out to determine the effects of magnetic field on the whitefly stages at different magnetic power and exposure periods. The whitefly pupae after the composition of the compound eyes showed more sensitivity and damage to different used magnetic powers. The pupae mortality and mal formation percentage was 100% with the power of 52 Gauss and exposure period 0.5 hr. Adults were more tolerant than other immature stages, however, they adults couldn't lay eggs.***

Key Words: ***Magnetic Field - Whitefly – Stages.***

INTRODUCTION

The whitefly, *Bemisia tabaci* Genn. (Homo.: Aleyrodidae) is one of the most important insects, that widely distributed all over the world.

Although the morphology, taxonomy, biology and economic importance of whiteflies have been investigated by several authors (El-Helaly, 1966). Relatively little attention was paid to it's physiological study.

In this concern, effect of eight-fold of magnetic fields on selective disadvantage of *Drosophila melanogaster* population was studied (Park *et al.*, 1999). Also, Broun *et al.* (1974) studied the ability of the electroeceptor system of the black sea rays, *Trigon pastinaca* for magnetic field perception.

According to Perez *et al.* (1999), magnetic field cause strong effect on migratory behaviour of the monarch butterfly (*Danaus plexippus*).

MATERIALS AND METHODS

The apparatus used was designed by the Department of Physics, Faculty of Science, University of Alexandria (Fig. 1).

It consists of two plates (10 cm in diam.), the external plate is made from aluminium, while the internal one was from iron. The distance between the two plates is equal to the diameter of the plate. The two plates were fixed in a style of wood and copper. Each plate was surrounded by wiren solenoid, its thick about 7 mm., conducts with Trans of 12 volt D.C., and another electric transformer.

To study the effect of magnetic field on the duration of the immature stages and adults of the whitefly *B. tabaci*, the insect stage were put on one

plate and exposed to the tested magnetic field (110, 160, 180, 200, 220 and 240 volt) which produced the following powers (36, 52, 59, 65, 72 and 79 Gauss*, respectively).

In the course of this study, were ½, 1, 2, 3, 12 and 24 hours exposure were tested, each period was replicated twenty five times (10 ♂:15 ♀). The experiment was achieved at laboratory conditions of 22 ± 1°C and 70% RH.

Fig. (1) :The used electro-magnetic apparatus

1- Bar of copper.
2- Upper wooden piece.
3- Magnetic poles.
4- Wiren solenoid.
5- Lower wooden base.
6- Transformer 4A (model$^{\sim}$ KBPC3506)$^{+}$ 12V-direct current.
7- Transformer – alternating current.

*** Gauss : Unit of the magnetic field.**

RESULTS AND DISCUSSION

Data in Table (1) show, the effects of the magnetic field power of 36, 52, 59, 65, 72 and 79 Gauss on mortality percentages of the whitefly stages.

1- Egg stage :

Data in Table (1) and Fig. 2 (A, B & C) showed that on significant differences were noticed between the exposure periods either 0.5 or 1 hr. on mean numbers of egg mortality, which were 53.57 and 54.86%, respectively.

Also, some of 1st linstar larvae could not emerge and to stick to eggs. The mortality percentage of eggs was 100% with period of 2, 3, 12 and 24 hrs.

In addition, results showed that the magnetic power of 36 and 52 G. occurred mean numbers of egg mortality of 38.67 and 61.67%, respectively. While, the highest power of 59, 65, 72 and 79 G. induced highly mortality percentage (100%) in eggs.

2- The larval stages :

Data in Tables (1 and 2) and Figure 2 (A, B & C) illustrated that the 1st instar larva is more sensitive to all used magnetic powers than 2nd and 3rd instar larvae.

When they were exposed to 2 hrs., mortalities reached 100%. The lowest power 36 G. and exposure period of 1 hr. gave 46.7% mortality.

Significant differences were obtained between mean numbers mortality of all larval stages when exposed to 36, 52 and 59 G. which gave the following percent mortality (41.67, 55.00 and 70.00), (24.33, 50.67 and 66.67) and (28.33, 58.67 and 70.67), respectively.

The mortality percentages increased gradually when both time and magnetic powers were increased.

Results indicated that the highest magnetic power of 65 G. gives highly mortality percentage (100%) at ½ hr espousing for all, larval stages.

3- Pupae stage:

The data showed that after the composition of the compound eyes, there are no significant differences between low time of ½ and 1 hrs., and mean number mortality values of 62.57 and 64.29%, respectively. On the other hand, mortality percentage were (100%) at exposure period of 2 hrs. and 52 G. magnetic power, Figure 2 (A, B & C). However 80% mortality with the lowest power of 36 G. and 1 hr. Also, the adult stage could not continue emergence from the exuvium pupal stage and observation more waxes secretions apparent around the abdomen of adult until death; Figure (3).This perhaps due to wax plates on 3rd – 6th segments (El-Helaly, 1966). Significant differences were noticed between magnetic powers (52 and 59 G.) and mean number of pupae before composition of eyes were mortalities (47.67 and 58.33%), respectively,.

Table 1

Table 2

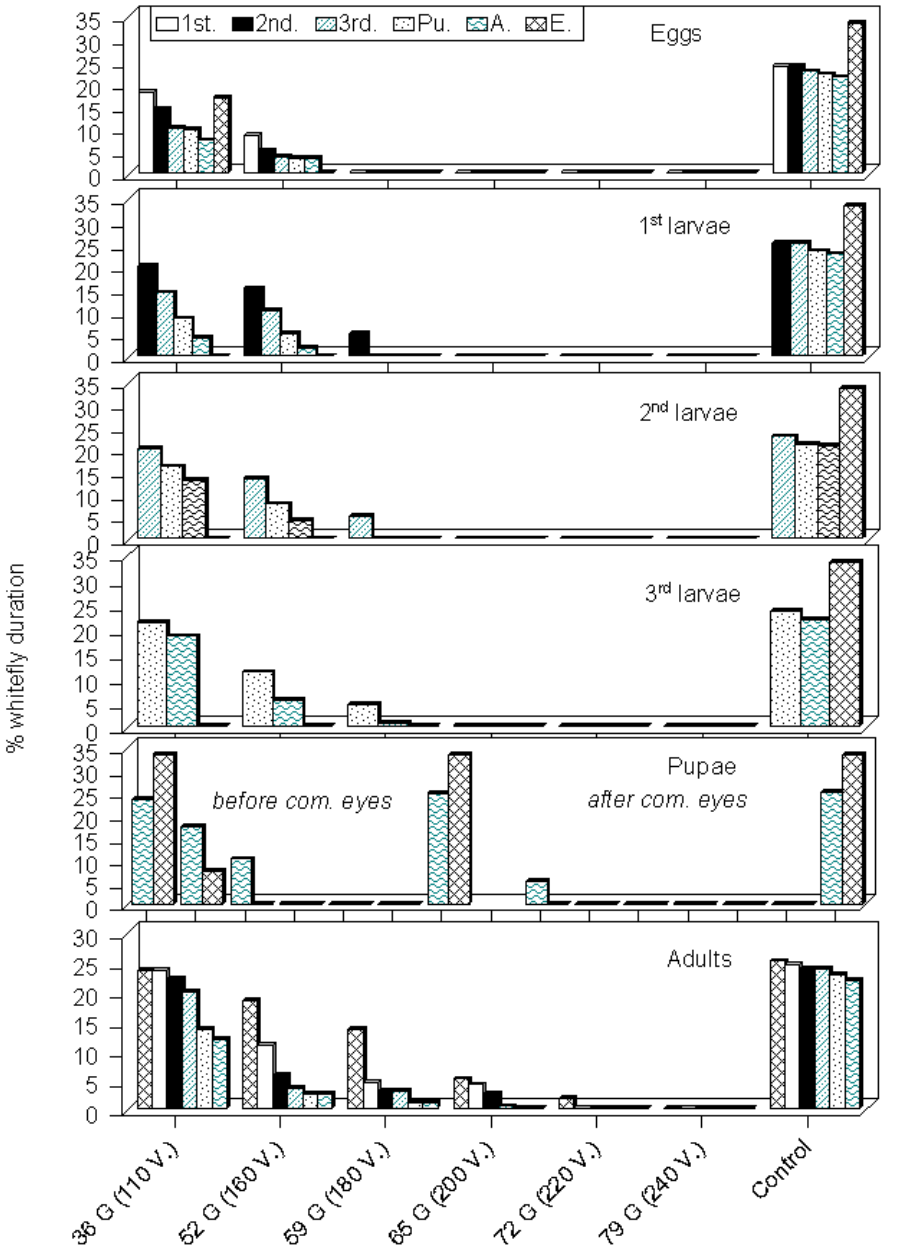

Figure 2 (A): Effect of magnetic field on the duration of the whitefly (*B.* tabaci) exposed for 30 min.

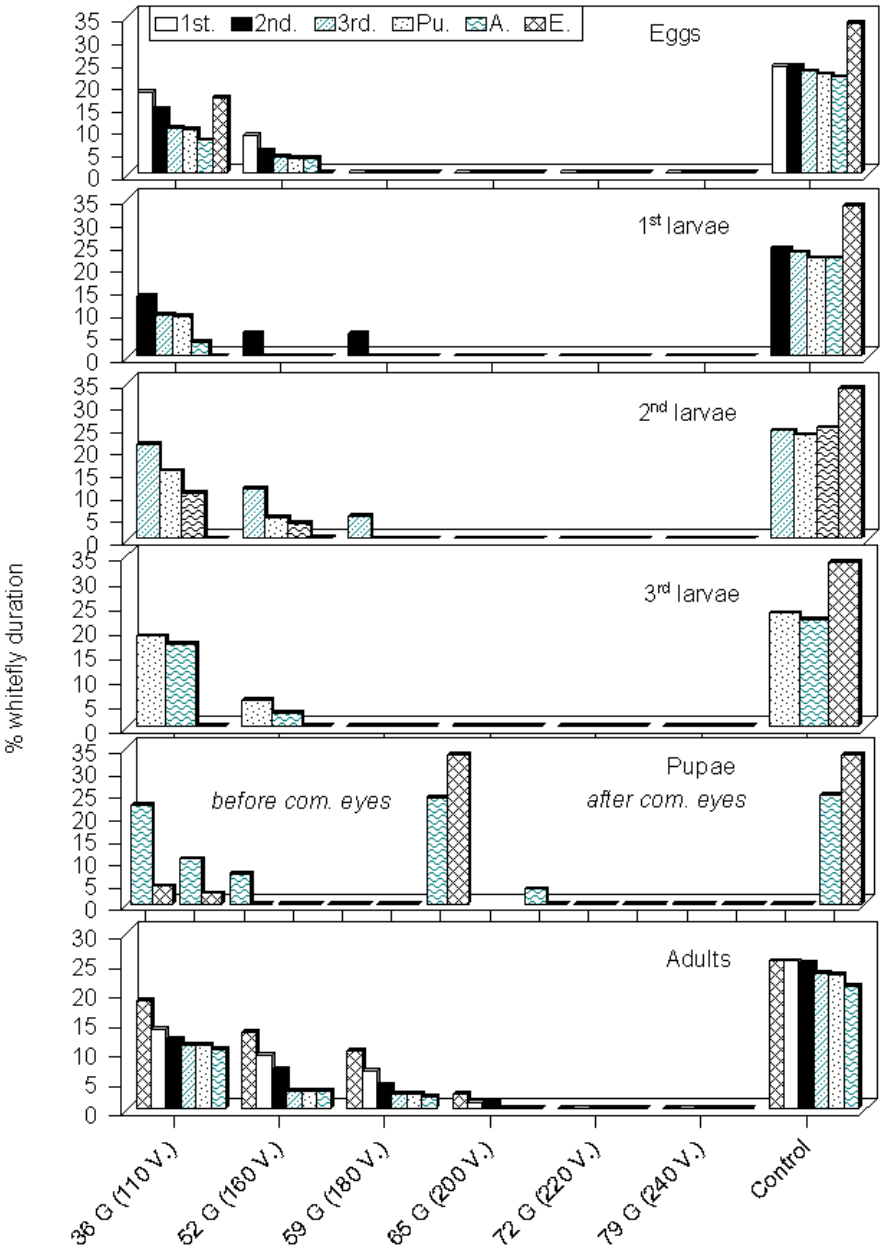

Figure 2 (B): Effect of magnetic field on the duration of the whitefly (*B.* tabaci) exposed for 60 min.

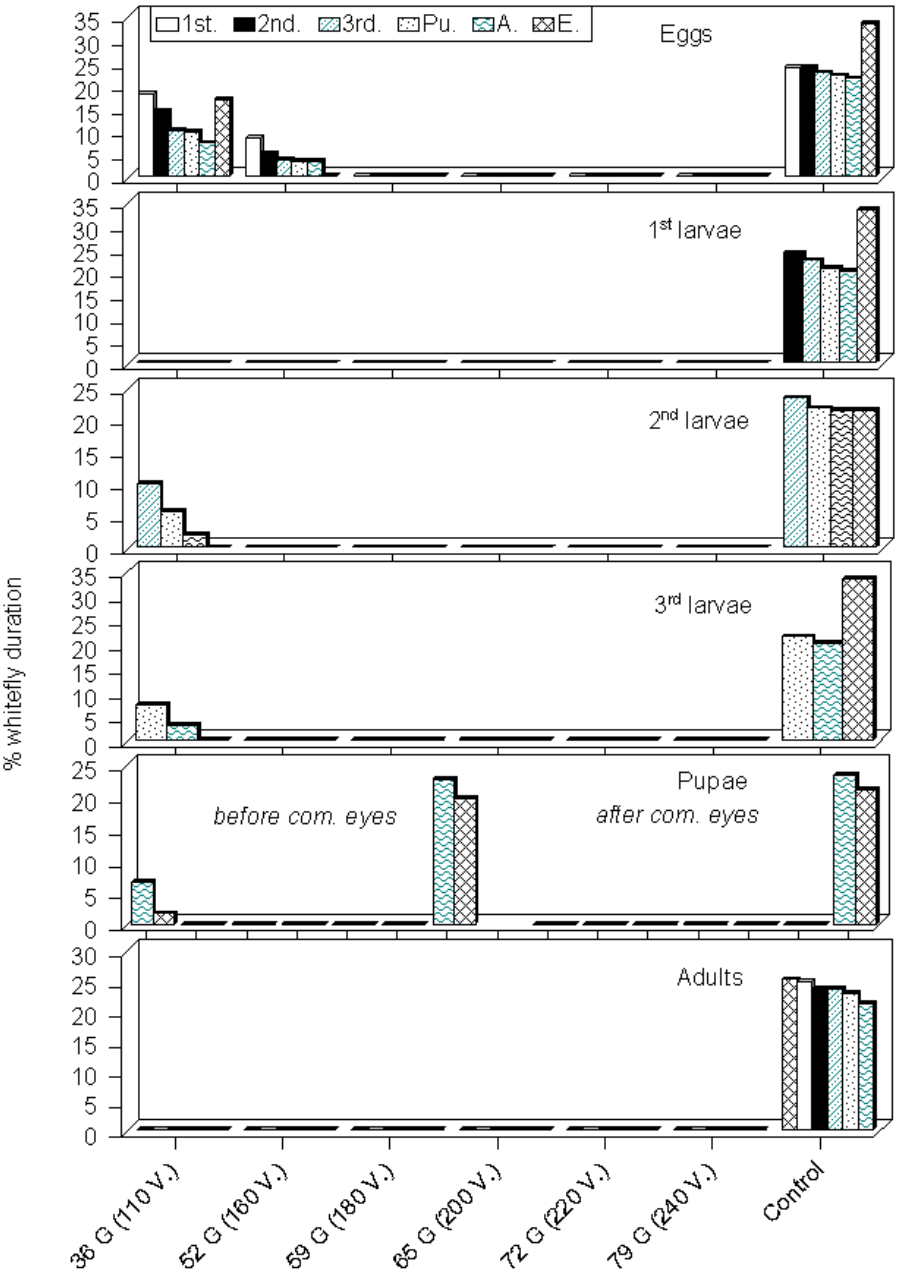

Figure 2 (C): Effect of magnetic field on the duration of the whitefly (*B.* tabaci) exposed for 120 min.

Figure (3): The adults stage could not continue emergence from the exuvium pupal stage.

The magnetic power (65 G.) gave 100% mortality. Statistical analysis revealed that the mortality percentage increased gradually by both time and magnetic power.

Generally, the results showed that the pupal stage after compound eyes was the highest sensitivity with the tested power than pupae before composition of eyes and other immature stages.

4- Adult stage:

Data in Table (3) and Figure 2 (A, B &C) indicated that mortality percentages increased with increasing magnetic powers. The highest magnetic effect was 72 G. at ½ hr. exposure period, which gave mortality of 100%.

Although magnetic power increased, its gave the same mortality percentages of (100%).

Table (3) refer that the mortality percentages was (100%) during 2 hrs. exposures period and with less magnetic powers (52 G.). There are no significant differences between the two exposure periods of ($^1/_2$ and 1 hrs.) and mean mortality numbers (55.00 and 60.57%), respectively.

The same observation was noticed between the periods of 1 and 2 hrs. with mean mortality numbers of (60.57 and 63.57%), respectively.

The whitefly adults were more tolerant than all immature white fly exposed to different magnetic's powers.

Results also showed that, male adults recorded the highest mortality in comparison with the female one. Also, the female adults were laid few egg, which not hatched.

In case of the highly magnetic power, females could not lay eggs. The eggs were failed to hatch and develop to other stages with highly magnetic powers.

Pupa stages after composition of eyes gave malformed adults, which could not complete its emergence from their exuvium.

The previous results are in agreement with those obtained by Park *et al.* (1999), who mentioned that, *D. melanogaster* population reared in eight-fold magnetic field showed stronger selected disadvantage.

Finally, data indicate that the whitefly pupae after composition of the compound eyes were more sensitive to the tested magnetic powers than larvae and adult stages, at ½ hr. of exposure period used.

Table 3

Acknowledgement

I wish to express my deepest gratitudes to both Dr. Amer Sowalem, Professor of Physic and Mr. Yousef El-Said Yousef, General Director of Physic's Laboratory, Department of Physic, Faculty of Science, University of Alexandria, for their generous co-operation by fearing several indispensable helps through out the determination of magnetic's apparatus and measurements needed during the achievement of the present work.

Many thanks go also to Dr. Laila M. Abd El-Naby and Dr. Ramadan Farrag, Plant Protection Research Institute, Agricultural Research Center, for reviewing of this work.Also, Deep thanks are due to Dr. Ahmed Saleh and Dr. Ahamed Ebeda, for their valuable assistance in the statistical analysis.

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تأثير المجال المغناطيسي علي أطوار ذبابة القطن البيضاء

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الملخص العربي

أجريت هذه الدراسة لتقدير مدي تأثير المجال المغناطيسي علي أطوار الذبابة البيضاء عندما تعرضها لقوي مجال مغناطيسي وكذلك لفترات زمنية مختلفة. أظهرت نتائج هذه الدراسة أن عذاري الذبابة البيضاء بعد تكون العيون المركبة تكون أكثر حساسية لقوي المجال المغناطيسي حيث أحدثت درجة عالية من هلاك وتشوه العذاري. وقد أظهرت النتائج أيضاً أن النسبة المئوية للموت كانت ١٠٠% عند تعرض العذاري بعد تكون العيون المركبة لقوي المجال المغناطيسي مقدارها ٥٢ جاوس ولفترة زمنية ½ ساعة. أيضاً أظهرت النتائج أن الحشرات الكاملة للذبابة البيضاء كانت أكثر الأعمار تحملاً لجميع قوي المجال المغناطيسي بالرغم من أنها لم تستطيع وضع بيض.

Table (1): Effect of magnetic field on mortality percentages of the white fly Eggs and 1st larvae when exposed to different periods.

Period / Power	Eggs							1st larvae						
	½ hr.		1 hr.		2 hr.		Mean numbers	½ hr.		1 hr.		2 hr.		Mean numbers
	Mortality							Mortality						
	No.	%*	No.	%*	No.	%*		No.	%*	No.	%*	No.	%*	
36 G. (110 V.)	21	28.0	20	26.7	75	100.0	38.67	15	20.0	35	46.7	75	100.0	41.67
52 G. (160 V.)	50	66.7	60	80.0	75	100.0	61.67	30	40.0	60	80,0	75	100.0	55.00
59 G. (180 V.)	75	100.0	75	100.0	75	100.0	75.00	60	80.0	75	100.0	75	100.0	70.00
65 G. (200 V.)	75	100.0	75	100.0	75	100.0	75.00	75	100.0	75	100.0	75	100.0	75.00
72 G. (220 V.)	75	100.0	75	100.0	75	100.0	75.00	75	100.0	75	100.0	75	100.0	75.00
79 G. (240 V.)	75	100.0	75	100.0	75	100.0	75.00	75	100.0	75	100.0	75	100.0	75.00
Control	4	5.33	4	5.33	0.0	0.0	2.67	2	2.67	3	4.00	0.0	0.0	1.67
Total	375		384		459			332		398		450		
Mean	53.57		54.86		64.29			47.43		56.86		64.29		
L.S.D.0.05 A =	5.3066							7.7927						
L.S.D.0.05 B =	3.85558							4.763028						
L.S.D.0.05AB=	6.13118							8.016362						

%* = Angular transformation was done applied/occurred.
G. = Gauss.
A = Period.
B = Magnetic field.

Table (2): Effect of magnetic field on mortality percentages of the white fly second and third in star larvae when exposed to different periods.

Period / Power	2nd larvae							3rd larvae						
	½ hr.		1 hr.		2 hr.		Mean numbers	½ hr.		1 hr.		2 hr.		Mean Numbers
	Mortality							Mortality						
	No.	%*	No.	%*	No.	%*		No.	%*	No.	%*	No.	%*	
36 G. (110 V.)	16	21.3	12	16.0	45	60.0	24.33	12	16.0	20	26.7	53	70.7	28.33
52 G. (160 V.)	35	46.7	42	56.0	75	100.0	50.67	42	56.0	59	78,7	75	100.0	58.67
59 G. (180 V.)	50	66.7	75	100.0	75	100.0	66.67	62	82.7	75	100.0	75	100.0	70.67
65 G. (200 V.)	75	100.0	75	100.0	75	100.0	75.00	75	100.0	75	100.0	75	100.0	75.00
72 G. (220 V.)	75	100.0	75	100.0	75	100.0	75.00	75	100.0	75	100.0	75	100.0	75.00
79 G. (240 V.)	75	100.0	75	100.0	75	100.0	75.00	75	100.0	75	100.0	75	100.0	75.00
Control	4	5.33	3	4.00	5	6.67	4.00	2	2.67	5	6.62	3	4.00	3.33
Total	330		357		425			343		384		431		
Mean	47.14		51.00		60.71			49.00		54.86		61.57		
L.S.D.0.05 A=	6.7583							3.0158						
L.S.D.0.05 B =	3.6248							5.1015						
L.S.D.0.05AB=	7.7487							10.9056						

%* = Angular transformation was done applied/occurred.
G. = Gauss.
A = Period.
B = Magnetic field.

Table (3): Effect of magnetic field on mortality percentages of the white fly pupae and adults when exposed to different periods.

Period / Power	Pupae (before composition eye)							Pupae (after composition eye)							Adults						
	½ hr.		1 hr.		2 hr.		Mean No.	½ hr.		1 hr.		2 hr.		Mean No.	½ hr.		1 hr.		2 hr.		Mean No.
	Mortality							Mortality							Mortality						
	No.	%*	No.	%*	No.	%*		No.	%*	No.	%*	No.	%*		No.	%*	No.	%*	No.	%*	
36 G. (110 V.)	5	6.7	9	12.0	59	73.3	28.33	60	80.0	70	93.3	75	100.0	68.33	30	40.0	59	78.7	65	86.7	51.33
52 G. (160 V.)	23	30.7	45	60.0	75	100.0	58.67	75	75.0	75	100.0	75	100.0	75.00	60	80.0	62	82.7	75	100.0	65.67
59 G. (180 V.)	45	60.0	55	73.3	75	100.0	70.67	75	75.0	75	100.0	75	100.0	75.00	70	93.3	73	97.3	75	100.0	72.67
65 G. (200 V.)	75	100.0	75	100.0	75	100.0	75.00	75	100.0	75	100.0	75	100.0	75.00	72	96.0	75	100.0	75	100.0	74.00
72 G. (220 V.)	75	100.0	75	100.0	75	100.0	75.00	75	100.0	75	100.0	75	100.0	75.00	75	100.0	75	100.0	75	100.0	75.00
79 G. (240 V.)	75	100.0	75	100.0	75	100.0	75.00	75	100.0	75	100.0	75	100.0	75.00	75	100.0	75	100.0	75	100.0	75.00
Control	1	0.9	4	5.33	3	4.00	3.33	3	4.0	5	6.67	4.0	5.33	4.00	3	4.00	5	6.67	5	6.67	4.33
Total	299		338		434			438		450		454			385		424		445		
Mean	42.71		48.29		62.00			62.57		64.29		64.86			55.0		60.57		63.57		
L.S.D.0.05A=	13.4131							2.5524							4.5848						
L.S.D.0.05B=	9.6131							6.9317							3.9710						
L.S.D.0.05AB=	14.1369							9.1552							8.7327						

%* = Angular transformation was done applied/occurred.
G. = Gauss.
A = Period.
B = Magnetic field.