Menoufia J. Plant Prot., Vol. 3 February (2018): 25 - 32

COULD MAGNETIC FIELD MINIMIZE STORING SEEDS INFESTATION WITH PESTS?

A. M. Hussein, Alyaa A. Tawfik, Walaa R. Abou Zeid and Ghada E. Abdalla
Plant Protection Research Institute, Agricultural Research Center, Dokki, Giza, Egypt

Received: Dec. 9 , 2017 **Accepted: Dec. 31 , 2017**

ABSTRACT: *This article was conducted to investigate the effect of the magnetic field as one of most recent techniques in storing seeds to control insects and mites infesting three main crops which constitute a relevant part of human and domestic animals diet. Seeds of three main important crops were chosen: Wheat, corn and kidney beans. Five kilograms seeds of each crop were taken and subjected to storing process for 9 months in a suitable containers. Storing technique depended on using a magnetic field among and between the grains and seeds under investigation. Each treatment was provided with 80 similar small magnet pieces, where each magnet was (1.5 cm) long with a 14-18 ml.T. magnetic power. As for wheat grains, the obtained results showed low values in infested seeds in the treatment , as it recorded 0.33, 1.0 and 13.00% in the 3 successive investigations of wheat in comparison with 1.33, 10.66 and 37% in (control), where there were highly significant differences in insect infestation specially after 6 and 9 months of storing. As for corn grains , the same trend was imphasized, as the infested seeds recorded low values when treated with the magnetic field 0.33, 1.3 and 12.67% along the 3 successive investigations while the control (without magnets) recorded high occurrence proportion, 1.33, 11.67 and 47.33% respectively. Results also indicated that in kidney beans the same effect for the magnetic field in minimizing the infested seeds, as it were 0.0, 0.0 and 7.33%, while the control recorded 0.33, 8.33 and 30.67% respectively. It could be deduce that Sitophilus granarius, in kidney bean was more affected than the other pests. This pest recorded 13.33 individuals in the control (without MF), against 3.33 individuals only in the treatment (with MF), which means that it was occurred 4 multiplies higher than in occurrence of magnetic field.*

Key words: *Magnetic field - Stored seeds - Pests - Infestation – Physical*

INTRODUCTION

Storing seeds is necessary and control different pests e.g. insects and mites is extremely important. Yakso and Gautam, (1993) referred to some old methods to control weevils of curculionidae and Apionidae families in wheat seeds. Hussein *et al*. (2017) referred to the effect of some modern and recent technologies e.g. magnetism against pests. Kuldipake *et al.* (2016) try to control some weevils in stored wheat seeds using some plant leaf powders, which achieved 13.33% mortality. Pinto *et al*. (2016) used some plant powders to control insect pests as maize weevil leaf, *Sitophilus zeamaize* in stored seeds. El-Bakry *et al*. (2016) evaluated the insecticidal activity of natural plant essential oils against some stored products, and found that the effect of the 5 tested essential oils varied based on insect species and application method. Bourget *et al*. (2012) examined the effect of magnetic field on ripening some vegetable fruits. Mano *et al*. (2006) studied the effect of extremely low magnetic field to suppress deterioration of some vegetable seeds. Liu Guang (1998) found that seeds germination rate, disease resistance of seedlings and seedlings height could be improved by exposing seeds to magnetic field. Jyotsana *et al* (2012) studied biochemical and biophysical changes associated with magneto-priming in cucumber seeds treated with 100-250 mT, and their results showed that the activities of hydrolytic enzymes, amylase and protease were greater than the untreated controls by 51% and 13% respectively. Tehseen *et al*. (2016) studied the effect of magnetic field on biochemical and enzyme activities in

soybean seeds. Mahesh *et al* (2015) studied how to delay ageing of soybean seeds by magnetic field by applying 50, 100 and 200 mT to seeds stored at room temperature for 6 months, where the obtained results showed that the treatments protected the quality of stored seeds in terms of its protein and oil content, furthermore, the obtained results revealed that the magnetic field treated seeds (100 and 200 mT) maintained a higher catalase and ascorbate peroxidase activity which help to eliminate the free radicals during the ageing. Jyotna *et al*. (2016) used 10 mT of magnetic field power to improve green pea seeds quality.

This paper aimed to investigate the effect of one of most recent techniques in storing seeds to control insects and mites infesting three main crops which constitute a relevant part of human and domestic animals diet, that using the magnetic field for this purpose.

MATERIALS AND METHODS

Improving methods of storing seeds is extremely important. Seeds of 3 main important crops were chosen: Wheat, corn and kidney beans. Five kilograms seeds of each crop were taken and subjected to storing process for 9 months in a suitable containers. Storing technique depended on using a magnetic field among and between the grains and seeds under investigation.

Site of storing was chosen in grains store shop to imitate and simulate storing places to ensure providing with infesting pests.

Samples was taken along 9 months, from each the seeds without magnetic field(S) (control), and from the seeds stored in magnetic field (treatment), (S+mag.). Investigation was carried out for the samples (3 replicates) after 3, 6 and 9 months. Investigation aimed to determine proportion of the infested seeds percentage in addition to numbers of obtained pest individuals, as will as their identification with taxonomical references. Water content percentages in the investigated seeds were determined after each 3 months, (in all the three crop seeds).

Creating and adjusting the magnetic field:

Appropriate cloth containers were just filled with the seeds (5 kilo grams) of wheat , corn and kidney beans in (3 replicates) to represent the control which means untreated seeds (S). To create a magnetic field among and inbetween the seeds of treatment: same weight of seeds (5) kg. was kept in same similar containers, in addition to 80 similar small magnet pieces. Each magnet was small (1.5 cm) long with a 14-18 ml.T. magnetic power. Measurements were carried out using mili-tesla meter in faculty of Engineering Menoufia University. One fifth (about 1 kg) of seeds first was put in the container, then 20 magnet pieces (from the 80) were arranged in a circle parallel of the outer diameter of the container, plus inside the circle in arranged position. Another one fifth of seeds (about 1 kg) was gently put on the magnets in the container, then (another 20 magnets) were fixed and arranged in the same former position and so on.

Finally we obtained 4 layers of magnet pieces (each 20) among 5 layers of wheat seeds (each 1 kg) to represent the treatment (S+mag), then repeated with corn and kidney beans. Samples were taken from the whole container after 3 , 6 and 9 months. Every once both of magnets and seeds perfectly again arranged in the same position. Results of investigation were tabulated in 3 main tables.

RESULTS AND DISCUSSION

The obtained results in Table (1) and depicted in Figs. (1 to 5) show the total sample weight which taken from the three investigated crops along 9 months. and water content percentage in the grains, and proportion of infested grains as percentage. Along three successive investigations which carried out after 3, 6 and 9 months respectively the results indicate that there is a general trend to increase in infested seeds with time of storing. In control of wheat crop, 37% of seeds were infested after 9 months in comparison with 1.33% only after

3 months, and 10.66% after 6 months respectively. The same table shows a decrease trend in seeds infestation in the treatment (storing accompanied with magnetic field) (S+mag.). Figures showed low values in infested seeds in the treatment , as it recorded 0.33, 1.0 and 13.00% in the 3 successive investigations of wheat in comparison with 1.33, 10.66 and 37% in (control), the case of storing without magnetic fields, which were with highly significant difference specially after 6 and 9 months of storing.

In respect of corn, the same trend was imphasized, as the infested seeds recorded low values when treated with the magnetic field 0.33, 1.3 and 12.67% along the 3 successive investigations while the control (without magnets) recorded high occurrence proportion, 1.33, 11.67 and 47.33% respectively. Results also indicated that in kidney beans the same effect for the magnetic field to minimize the infested seeds, as it were 0.0, 0.0 and 7.33%, while the control recorded 0.33, 8.33 and 30.67% respectively.

The obtained results in Table (1) also indicate that, there was an average decrease in infestation percentage causing to use the magnetic field up to 4.78% in comparison with 16.33% (in control without magnetic field), which means 3.42 folds improving in storing wheat seeds. In respect of corn the same indicator revealed that the average decrease in infested seeds reached 4.78% rather than 20.11% in case of storing the corn without magnets, which means 4.21 folds in improving storing process. Results also, showed that the kidney beans crop recorded the highest value in improving storing process 5.37 folds, as the average decrease of infested seeds were 2.44%, while it recorded 13.11% in control. Also, it is notable to mention that, there was no any pests (0.0%) till period of 6 months in kidney bean seeds. In case of using the magnetic field. Joo *et al*. (2004) In their research applied electromagnetically treatments on wheat, they proven that the cause of higher vitality of wheat is connected with the non-thermal effect of the electromagnetic field. Sekhon *et al*. (1985) Showed that the durum wheat CV. DWL. 5023 was more resistance to grain wetting than 4 Soft wheat CV. seeds stored after drying and exposed to magnetic field before sowing than untreated seeds. Khlebnyi *et al*. (1976) Showed that treatment of spring wheat seed in magnetic field increased their yielding quality.

Table (1): Percentage of infested grains in the three investigated crop seeds.

Treatments	1st investigation 20/8/2016			2nd investigation 20/11/2016			3rd investigation 20/2/2017			(no. of folds) Ave.
	weight (g.)	water content %	Infested grains %	weight (g.)	water content %	Infested grains %	weight (g.)	water content %	Infested grains %	
Wheat										
Co.	350	12.99	1.33	288	13.86	10.66	230	19.2	37	(3.42) 16.33
Tr.	358	9.86	0.33	328	10.76	1.0	272	1057	13	(-) 4.78
Corn										
Co.	345	13.52	1.33	291	13.29	11.67	218	17.71	47.33	(4.21) 20.11
Tr.	350	9.84	0.33	312	6.87	1.3	276	9.93	12.67	(-) 4.78
Kidney bean										
Co.	309	13.29	0.33	256	11.51	8.33	221	20.88	30.67	(5.37) 13.11
Tr.	323	7.96	0	304	6.66	0	264	10.48	7.33	(-) 2.44

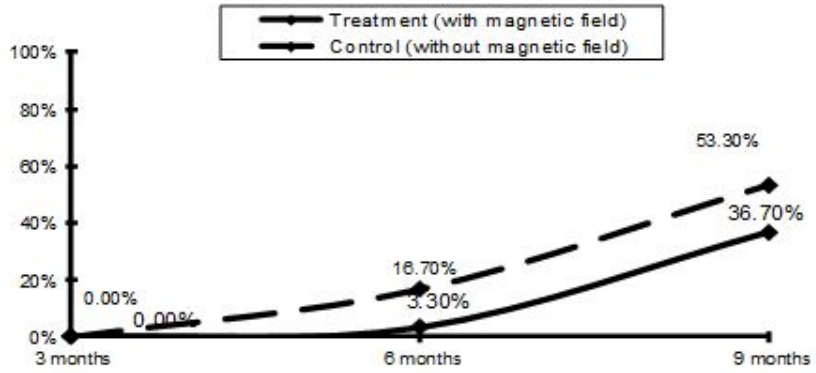

Fig. (1).. *Tribolium castaneum* (Herbst) Wheat

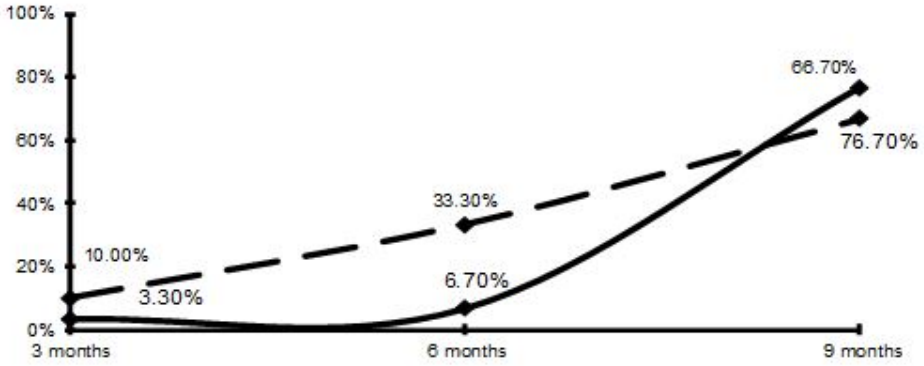

Fig. (2). *Rhyzopertha dominica* (Fabrcius) Wheat

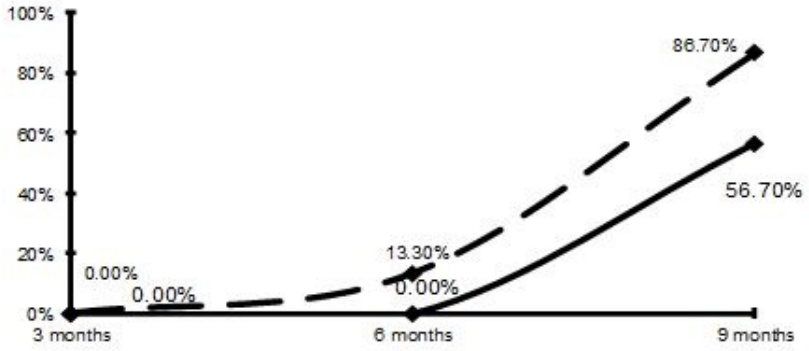

Fig. (3). *Tyrophagus putrescentiae* Wheat

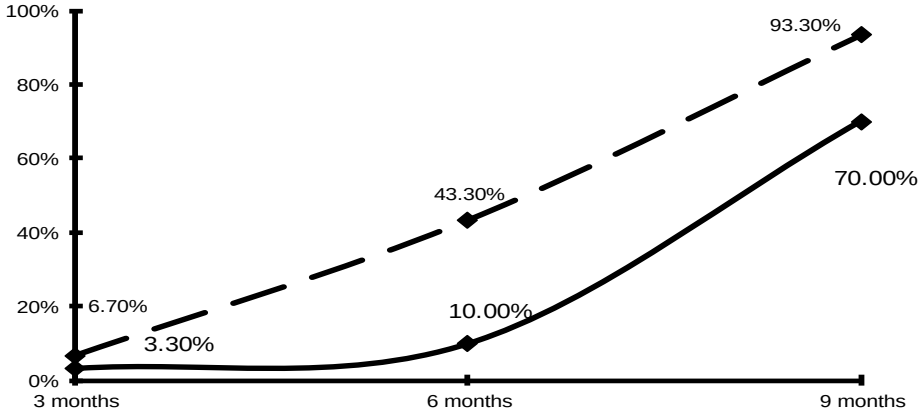

Fig. (4). *Sitophilus granaries, (*L*)* Corn

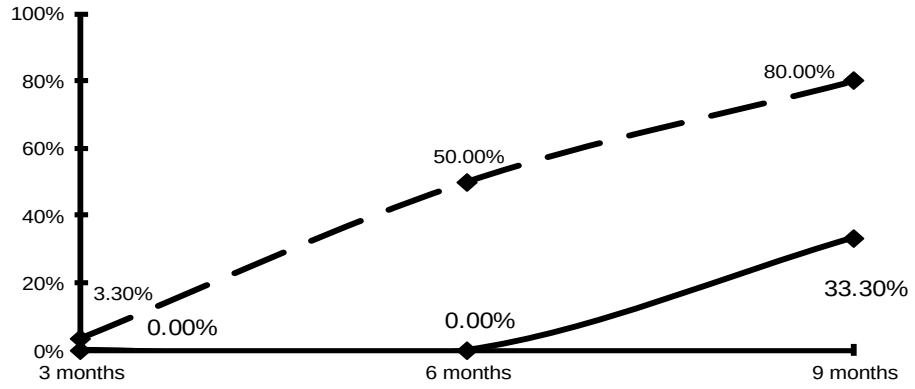

Fig. (5). *Sitophilus granaries, (*L*)* Kidney been

In addition, results in Table (2) show the successive appearance and density of four different pests during investigations. There were (3) in wheat: *Tribolium custaneum, Rhyzopertha dominica and Tyrophagus putrescentiae.* In addition to *Sitophilus granarius* in both corn and kidney bean. Densities of the different pests showed considerable low values in case of accompanied with magnetic field (MF) in comparison with the control (without MF). Average numbers of all pests after 3 months recorded 0.40 individuals in the control (without MF), while it was only 0.13 individuals in the treated grains with the magnetic field. That means the average numbers of all the pests in the control were 3.08 multiplies higher than those in the seeds with magnetic field (treatment). Maximum improving in the storing process

was recorded after 6 months, as the pests were higher 7.83 multiplies in control than those of seeds with magnetic field (MF), as it recorded 3.13 individual / sample in the control against only 0.40 individual / sample when it was accompined with the magnetic field. Densities of pests in both control (without MF) and the treatment (with MF) were with near values after 9 months. As it recorded 7.6 and 5.47 individuals respectively , which means 1.39 folds only, and means also, the optimum period to get benefits in storing is for six months only.

Table (3) indicates the density of each pest in both treated and non treated grains along the storing period (9) month. It could be deduce that *Sitophilus granarius,* in kidney bean was more affected than the other pests. This pest recorded 13.33 individuals in the control (without MF), against 3.33 individuals only in the treatment (with MF), which means that it was occurred 4 multiplies higher than in occurrence of magnetic field.

Table (2): Average number of different obtained pests on the 3 investigated crops stored under magnetic field for 9 months.

Crop	Pests	1st investigation 20/8/2016		2nd investigation 20/11/2016		3rd investigation 20/2/2017	
		Co.	Tr.	Co.	Tr.	Co.	Tr.
Wheat	*Tribolium castaneum* (Herbst)	0.00	0.00	1.67	0.33	5.33	3.67
	Rhyzopertha dominica (Fabrcius)	1.00	0.33	3.33	0.67	6.67	7.67
	Tyrophagus putrescentiae (Schrank)	0.00	0.00	1.33	0.00	8.67	5.67
Corn	*Sitophilus granarius* (L)	0.67	0.33	4.33	1.00	9.33	7.00
Kidney bean	*Sitophilus granarius* (L)	0.33	0.00	5.00	0.00	8.00	3.33
Σ		2.00	0.66	15.66	2.00	37.00	27.34
$\overline{X}$.		0.40	0.13	3.13	0.40	7.60	5.47
S.D.		0.39	0.16	1.44	0.39	1.44	1.73
N.F.		3.08	-	7.83	-	1.39	-

(Σ): Total , (X.) Average (S.D.) Standard Deviation (N.F.) Number of Folds

Table (3): Average number of the pests obtained from each control and the treated samples along period (9 months)

Crop	Pests	Co.	Tr.	N.F.
Wheat	*Tribolium castaneum* (Herbst)	6.93	4.00	1.73
	Rhyzopertha dominica (Fabrcius)	12.00	8.67	1.38
	Tyrophagus putrescentiae (Schrank)	10.00	5.67	1.76
Corn	*Sitophilus granarius* (Linnaeus)	14.33	9.33	1.50
Kidney bean	*Sitophilus granarius* (Linnaeus)	13.33	3.33	4.00

REFERENCES

Bourget, S., R. Corcuff, P. Angers, J. Arul, P. M. A. Toivonen, J. P. Mattheis, D. R. Rudell (2012). Effect of the exposure to static magnetic field on the ripening and senescence of tomato fruits. Acta Horticulturae; (945):129-133.

El-Bakry, A. M., N. F. Abdel-Aziz, E. A. Sammour and S. A. M. Abdelgaleil (2016). Insecticidal activity of natural plant essential oils against some stored product insects and their side effects on wheat seed germination. Egyptian Journal of Biological Pest Control; 2016. 26(1):83-88.

Hussein, A. M., Ghada E. Abdalla, Mariam G.H., Amal E.M. and M.H. Mahgoub (2016). Is the magnetized sea-water could act as a new alternative acaricide?. Menoufia J. Plant Prot., 2: 183-190.

Joo, E., P. Szendro, G. Vincze and A. Szasz (2004). Assessment of electromagnetically treated wheat kernel at 120 Hz using the FDTD method. Acta Technologica Agriculturae; 7(4):101-105.

Jyotsna Bhardwaj, Anjali Anand, V. K. Pandita and Shantha Nagarajan (2016). Pulsed magnetic field improves seed quality of aged green pea seeds by homeostasis of free radical content. Journal of Food Science and Technology (Mysore); 53(11):3969-3977.

Jyotsna Bhardwaj, Anjali Anand and Shantha Nagarajan (2012). Biochemical and biophysical changes associated with magnetopriming in germinating cucumber seeds. Plant Physiology and Biochemistry; 5767-73.

Khlebnyi, V. S., A. S. Aref'ev and E. V. Kleimenov (1976). Effect of magnetic field, ion bombardment and laser-irradiation on sowing and yielding qualities of seeds. [Russian] Trudy, Gor'kovskii Sel'skokhozyaistvennyi Institut; 102: 33-38.

Kuldipake, S. A., B. M. Mhaske and N. M. Patil (2016). Study of mortality and repellency of rice weevil Sitophilus oryzae L. on wheat seeds during storage. International Journal of Plant Protection; 9(2):479-482.

Liu Guang, X. (1998). A study on the technique of magnetic cultivation and early screening of quick-grown and disease-resistant seedlings of Pinus taeda. [Chinese] Wuyi Science Journal; 14: 222-225.

Mahesh Kumar, Bhupinder Singh, Sumedha Ahuja, Anil Dahuja and Anjali Anand (2015). Gamma radiation and magnetic field mediated delay in effect of accelerated ageing of soybean. Journal of Food Science and Technology (Mysore); 2015. 52(8):4785-4796.

Mano, J., T. Nakahara, Y. Torii, H. Hirose, J. Miyakoshi and K. Takimoto (2006). Seed deterioration due to high humidity at high temperature is suppressed by extremely low frequency magnetic fields. Seed Science and Technology; 34(1):189-192.

Pinto, J. J., G. Silva, I. Figueroa, M. Tapia, A. Urbina, J. Concepcion Rodriguez and A. Lagunes (2016). Insecticidal activity of powder and essential oil of Cryptocarya alba (Molina) Looser against *Sitophilus zeamais* Motschulsky. Chilean Journal of Agricultural Research; 2016. 76(1):48-54.

Sekhon, S. S., Bhupinder Singh and O. S. Singh (1985). Quantifying the effects of magnetic field on repair process and invigoration of rain-soaked wheat. Indian Journal of Ecology; 12(2):337-343.

Tehseen Asghar; Yasir Jamil, Munawar Iqbal, Zia-ul-Haq and Mazhar Abbas (2016). Laser light and magnetic field stimulation effect on biochemical, enzymes activities and chlorophyll contents in soybean seeds and seedlings during early growth stages. Journal of Photochemistry and Photobiology. B, Biology; 165: 283-290.

Yakso, K. M. and T. Gautam (1993). A report on an extension poster: a pilot test carried out at Murtidhunga and Jitpur Village Development committees of Dhankuta district. PAC Working Paper - Pakhribas Agricultural Centre; (61):13pp.

ماذا عن تقليل الإصابة بالآفات عند التخزين في مجال مغناطيسي؟

عبد الخالق محمد حسين ، علياء عبد القادر توفيق ، ولاء محمد رشدي أبو زيد ، غادة السيد عبد الله

معهد بحوث وقاية النباتات – مركز البحوث الزراعية

الملخص العربي

في تجربة لتخزين ثلاثة أنواع من الحبوب : القمح و الذرة و الفاصوليا تم عمل 3 مكررات من بذور كل نوع ووضع 5 كجم في (جوال قماش صغير مناسب) والاحتفاظ به لمدة 9 شهور مع أخذ عينة (من كل مكررة) للفحص كل 3 شهور و تسجيل أنواع و أعداد ما يظهر بها من آفات حشرية و / أو أكاروسية

وتم عمل أجولة مماثلة مع إضافة مجال مغناطيسي بكل وعاء عن طريق استخدام 80 قطعة مغناطيسية صغيرة (1.5 سم) ذات قوة مجال قدرها 14–18 ميللي تسلا لكل قطعة مع ترتيب هذه القطع في 4 طبقات بين الحبوب في كل وعاء. وتم تخزين أجولة الكنترول (بذور فقط) وأجولة المعاملة (بذور في مجال مغناطيسي) في مكان مناسب للتخزين.

وأوضحت النتائج أن وجود المجال المغناطيسي أدى إلى خفض في تعداد جميع الآفات بجميع المحاصيل حيث سجلت 4.78، 4.78، 2.44، فرد/عينة مقابل 16.33 ، 20.11 ، 13.11 فرد/ عينة كمتوسط في محاصيل القمح و الذرة و الفاصوليا على الترتيب (جدول 1). و أعلى خفض للآفات كان في الفاصوليا إذ سجلت الأعداد في الكنترول 5.37 ضعفاً أعلى منها في ظروف التخزين في مجال مغناطيسي

كما أظهرت النتائج أن أحسن مدة تخزين كانت هي 6 شهور حيث كانت أعداد الآفات في الكنترول أكبر بـ 7.83 مرة عنها في المعاملة (ذات المجال المغناطيسي) (جدول 2). وكذلك أظهرت النتائج أن أكثر الآفات التي تأثرت بالمجال المغناطيسي كانت هي *Sitophilus granarius* خاصة في محصول الفاصوليا إذ سجلت 13.33 فرد في الكنترول مقابل فقط 3.33 فرد في ظروف التخزين المقترنة بالمجال المغناطيسي (جدول 3).

أسماء السادة المحكمين

أ.د/ سعيد عبدالعظيم عـــلام معهد بحوث وقاية النبات – الجيزة

أ.د/ محمد الأمين محمد سويلم كلية الزراعة – جامعة المنوفية