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Efficacy of Magnetic Field on Activities of some Chemical Fungicides on some Pathogenic Fungi Caused Damping – Off and Charcoal Rot on Sesame (*Sesamum indicum* L.) Plants

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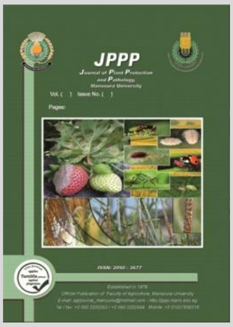

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ABSTRACT

Efficacy of magnetic field (MF) (5 mT/12, 24, and 36 h) on growth of *Aspergillus flavus, Aspergillus niger, Macrophomina phaseolina, Fusarium solani, Trichoderma harzianum* and *Trichoderma viride* were investigated *in vitro*. *A. niger* was the most sensitive to MF for 12 h with a growth inhibition 66.22% followed by *M. phaseolina, A. flavus, F. solani, T. harzianum* and *T. viride*. Also, the inhibition increased with increasing exposure periods up to 36 h. Qualitative protease and amylase activities of the magnetized pathogenic fungi were less compared to non-magnetized fungi. Amylase activity did not detect on the medium of exposed *A. niger*. The effect of magnetized Moncut 25%, Celest, and Rizolex-T 50% wp (MF) and sesame seeds *cv*. Giza 32 (MS) were studied on the infection with *M. phaseolina* under greenhouse conditions for two seasons (2022 and 2023). (MF + MS) prevented the pre-emergence damping – off followed by MF and NMF treatments for both seasons. The least of both post emergence damping – off and charcoal rot incidence were noticed with (MF + MS) treatment. And it had the highest values of peroxidase activity (PX) and total phenol content (TPC). Pre- emergence damping – off strongly and moderately correlated with (PX) and (TPC), recording r = - 0.85 and - 0.81, respectively. Strong correlation was cleared with the post – emergence damping – off and (PX) and (TPC), recording r = - 0.89 and - 0.85, respectively**.** (PX) and (TPC) had moderate correlation with disease incidence recording r = - 0.81 and - 0.84, respectively.

Keywords: Magnetic field - Charcoal rot - sesame – enzymes - total phenols.

INTRODUCTION

The decrease in crop productivity has been attributed to both global climate variations and population growth. To counteract this shortage and increase agricultural productivity, chemicals have been used for decades as fertilizers, herbicides, and pesticides to improve the crop yield (Xuesong *et al*., 2021). A report by the World Health Organization indicated that there are 200,000 deaths per year because of pesticide poisoning. This corresponds to at least 3 million cases per year of poisoning of people, mostly children, therefore, natural and alternative methods or applications are being researched to increase food quality and yield. Static magnetic field, one of the methods used in recent years, is used to improve plant development (Pentoś *et al.,* 2022).

Sesame (*Sesamum indicum* L.) is one of the best sources of protein (18–20%), oil (46–52%), and many vital minerals including potassium, phosphorus, and calcium, as well as vitamins like vitamin E (El-Saidy *et al*., 2009). In Egypt sesame has been grown in a variety of soil types. The cultivated area of sesame in Egypt in the summer season of 2020 was about 29 thousand hectare which produced about 38 thousand tons (Mahdy *et al.,* 2023).

Macrophomina phaseolina (Tassi) Goid is a member of the family *Botryosphaeriaceae*, it causes a severe threat to oilseed plants, specifically sesame, sunflower, corn and cotton causing significant economic losses. Alternative methods for managing these infections are therefore becoming more and more necessary (Amin and Abd-Elbaky**,** 2024 and Machado *et al*., 2019).

Magnetic field (MF) technology has been shown to significantly improve plant development in various species. MF doesn't produce dangerous radiation, release waste, or needs an external power source (Sarraf *et al.,* 2021). MF affects various plant functions, such as growth, development, protein biosynthesis and enzyme activity (De Souza *et al.,* 2006; Sarraf *et al.;* 2020 and Tirono *et al.,* 2021). MF has been found to be an effective and emerging tool to control diseases and increase tolerance against adverse environments. It weakens and inhibits the growth of fungi and other infectious microorganisms. This growth suppression was followed by morphological and biochemical alterations, as well as a decrease in fungal conidia germination and cell survival (Pal**,** 2005 and da Silva *et al.,* 2021). The growth rate of *Plasmopara viticola, Rhizopus stolonifer, Asperguillus niger and Rhizopus nigricans* exposed to static magnetic field was inhibited. Morphological changes were observable on the conidia of *Aspergillus puniceus* and *Alternaria alternate* and the pigmentation of the colony of *Aspergillus niger* changed where the cultures remained white (Radhakrishnan, 2019). Also, Abd El-Nabi *et al.*, (2013) found that the MF decreased the growth colonies of *Alternaria alternata, Curvularia inaequalis* and *Fusarium oxysporum*, the number of *Fusarium oxysporum* conidia and the growth of *M. phaseolina*, *R. solani*, and *F. oxysporum in vitro* were suppressed by magnetic water. Abdelhameed (2014) exhibited that the exposure of *Sclerotium cepivorum* to Dynamic magnetic field led to decreasing of the disease incidence and severity. Phytopathogenic fungi are characterized by their ability to secrete lysosomal enzymes such as protease**,** tyrosinase, Phenol oxidase, Amylase**,** Lipase and Cellulase that give them the ability to penetrate and colonize host tissues (Pal, 2005).

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Plant enzymes play a critical role in pathogenesis, infection, and defense. Elevated activity levels of these enzymes have been observed to correlate with infected tissues. Peroxidases are vital enzymes that regulate plant growth and development, eventual lignification, as well as the protection of tissue against injury and infection (Pal, 2005 and da Silva *et al.,* 2021).

The aim of this research was to investigate the efficacy of magnetic field at 5 mT for three periods: 12, 24 and 36 hours on the growth of some pathogenic fungi, its effect on sesame charcoal rot disease under greenhouse conditions and the relation between the magnetic field treatments and the activity of some fungicides.

MATERIALS AND METHODS

Fungal Isolates:

Fungal isolates: *Aspergillus flavus, Aspergillus niger,* and *Fusarium solani,* were kindly provided from the Department of Mycology and Plant Diseases. *M. phaseolina* was obtained from Onion, Garlic and Oil Crops Disease Department, Plant Pathology Research Institute, Agricultural Research Centre, Giza. Bio-control fungi *Trichoderma harzianum* and *Trichoderma viride* were obtained from the department of Biological Control Res. Dept. Plant Pathology Res. Instit., Agric., Res. Center Giza, Egypt.

Laboratory Experiment:

Effect of magnetic field on fungal growth on solid media:

Plates of 7- day - old fungal cultures were exposed to a magnetic field of 5 mT for several durations: 12, 24, and 36 hours (Beretta *et.al.,* 2019). The diameter of the fungal colonies of the magnetized fungal plates and the non-magnetized fungal plates (control) were measured when the fungal growth covered the control plates following the formula:

Inhibition % = [FGD in control – FGD in the treatment / FGD in control] X 100

FGD: fungal growth diameter

Effect of the magnetic field on the activity of some fungicides:

Method of magnetizing fungicides:

Each chosen fungicides (Rizolex-T 50% wp, Moncut 30% and Celest) were used at their commercial concentrations was placed separately in glass test tubes and put in the magnetic field of 5 mT for periods (12, 24, and 36 h**.**) For the control treatment, fungicides were placed in a similar tube without magnetization. Three replicates were made for each fungicide.

Table 1. fungicides used in this investigation.

Commercial name	Common name	Chemical name	Application rate/Liter
Rizolex-T WP 50%	Telcolofos-methyl/thiram	20% Telcolofos- methyl (0,2,6 dichloro-4methyl-phenyl 0,0 dimethyl phosporo thioate) and 30% thiram	3.0 g/L
Celest	Fludioxonil	4-(2,2- difluoro – 1,3 – benzodioxal – 4-yl)-1 *H*-pyrrole- 3- carbonitrile	1.5 ml /Kg seed
Moncut WP 30%	Flutolanil	N-(3-(1-methylethoxy)-2-(trifuoromethyl)benzamide	2.0 g/L

Effect of magnetized fungicides on fungal growth in the water agar medium *in vitro*:

Pathogenic fungi under study; *A. flavus, A. niger, M. phaseolina* and *F. solani* and bio-control fungi; *T. harzianum* and *T. viride*, were cultured on water agar medium plates and let to grow for 24 h at 25±2°C. Radish seeds cv. Balady white (as a sensitive plant) was sterilized with sodium hypochlorite at a concentration of 2% for two minutes, washed with sterile distilled water twice and soaked in magnetized fungicides and used as indicator to the activity of magnetized fungicides. After 15 min of soaking in the magnetized fungicides, they have been dried using a sterile filter paper and planted on the pre-fungal-inoculated petri dishes, 10 seeds/ plate at 1 cm from the edge of the dish, in a circular manner. (Allwbawi *et al.,* 2018). After seven days, the percentages of germination and rotted seeds were calculated, depending on the following equations:

Germination (%) = [germinated seeds no./ total seeds no.] X 100

Rotted seeds (%) = [rotted seeds no. / total planted seeds no.] X100

Healthy seedlings (%) = [healthy seedlings no./ total seedlings no.] X100

Greenhouse Experiments:

Effect of magnetic field on infected sesame plants for charcoal disease under greenhouse conditions for two seasons:

Greenhouse experiment was conducted in plastic pots with 30 cm in diameter each pot was filled with 5 kg of soil and infected with *M. phaseolina* isolate. The most susceptible cv. Giza-32 was obtained from the Field Crop Research Institute, ARC, Giza and revealed in the pathogenicity test.

After 7 days of pot infestation, half of pots were planted with sesame seeds treated with magnetized Celest fungicide at 5mT for 24h (10 seeds/pot) at the recommended commercial dose. Another half pots were planted with only magnetized seeds which were exposed for 30 min before sowing with 5 mT without any fungicide treatment.

Disease incidence was recorded using the equation of:

DI= (number of infected plants/total number of plants) x100.

The treatments were arranged in a completely randomized block design with three replicates, as follows:

1- Magnetized Fungicide (MF)
2- Non- magnetized Fungicide (NMF)
3- Magnetized seeds (MS)
4- Magnetized Fungicide + Magnetized seeds (MF + MS)
5- Infected only (positive control)
6- sesame seeds sown in un-infested soil without any treatment (negative control)

Physiological traits:

Determination of plant peroxidase and total phenol content:

The activity of peroxidase enzyme (POX) was directly measured in the crude enzyme extract using the methodology outlined by (Thimmaiah, 1999) 3gm fresh leaf taken off from 20-day-old seedlings was homogenized at 0-4˚C in 9 ml of 0.1 M phosphate buffer (pH 7.1). The homogenates were cooling centrifuged at 3,000 rpm (4˚C) for 20 minutes (min). Total soluble phenols in fresh leaves were determined using the colorimetric method described by (AOAC, 1985).

Fungal amylase and protease assay

The ability of the magnetized pathogenic fungi, *A. flavus, A niger, F. solani and M. phaseolina.* (5 mT for 36h.) to produce extracellular enzymes was assessed on solid media. To visualize enzymatic activity, a particular substrate for each enzyme was included into the culture medium as a carbon source. A plug of the fungal growth was added in the center of petri plate and incubated. Fungal isolates were incubated for 3-6 days depending on their growth rate. The appearance of a clear halo or precipitation around the fungal growth indicates enzyme production.

Amylolytic activity of each fungus was observed using the methodology of (Hankin and Anagnostakis, 1975) by adding 2gm/L of soluble starch was added to PDA medium, after incubation, plates were flooded with 5 mL of iodine solution. After about 10 min., the clear hallow around the fungal growth, in contrast with a purple background, indicates the presence of amylase.

For protease detection, the method of (Sarath *et al*., 1989) was used. 30% skimmed milk was added to PDA medium. Following incubation, the breakdown of casein was indicated by a distinct zone surrounding the fungal growth.

Enzymatic activities were determined according to the scale of (Hammod, 1989).

The magnetic field device

The device used for inducing magnetic field for fungi and seeds treatments was designed and implemented at the Center for Maintenance of Scientific and Electronic Devices, Department of Physics, Faculty of Science, Cairo University as shown in Fig. (1). The magnetic force was interpreted to gauss (Gu) by using the device standard curve (Fig. 2) then it converted to mT by multiplying the Gu by 10 (1 mT = 10 Gu). Accordingly, the chosen magnetic field strength for treating fungi and seeds is 5 mT, which was 50 Gu that equal to 46.4 volt (Fig. 2).

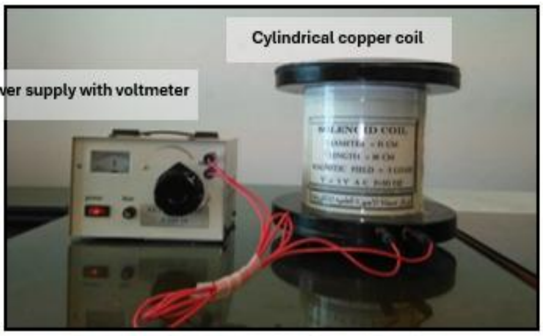

Fig.1. The device used for inducing magnetic field (minimum 5 V, 5 Gu)

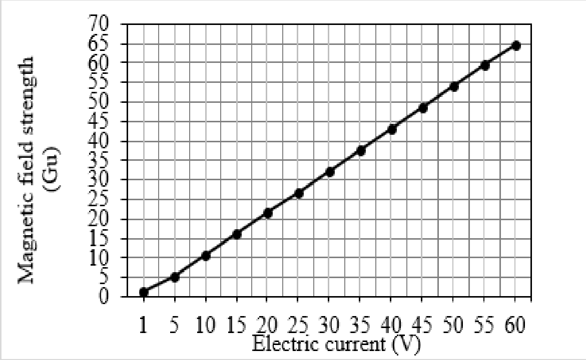

Fig. 2. The standard curve for the device that converts the voltmeter reading (V) to magnetic field (Gu).

RESULTS AND DISCUSSION

Data presented in Table (2) show the effect of exposed *A. flavus, A. niger, M. phaseolina, F. solani, T. harzianum and T. viride* to magnetic field at 5 mT for 12, 24 and 36 h on its diameter growth (cm) *in vitro*. From Fig (3) it is clear that, *A. niger* was the most sensitive to the magnetic field exposure period of 12 h with a growth inhibition 69.22% followed by *M. phaseolina, A. flavus, F. solani, T. harzianum* and *T. viride* with averages of 64.78, 37.00, 20.33, 11.11 and 11.11%, respectively. Also, it is clear that, the fungal growth inhibition increased with increasing exposure period up to 36 h with averages of 77.78, 72.22, 53.33, 29.67, 27.78 and 22.22% for *M. phaseolina, A. niger, A. flavus, F. solani, T. harzianum* and *T. viride*, respectively.

Table 2. Effect of magnetized pathogenic and nonpathogenic fungi at 5 mT for 12, 24 and 36 h on its growth diameter (cm).

Fungi	Exposure time (h)						Mean	
	12h		24h		36h			
	Growth diameter (cm)	Inhibition %	Growth diameter (cm)	Inhibition (%)	Growth diameter (cm)	Inhibition %	Growth diameter (cm)	Inhibition (%)
A. flavus	5.67	37.00	4.83	46.33	4.20	53.33	4.90	45.56
A. niger	2.77	69.22	3.03	66.33	2.50	72.22	2.77	69.22
M. phaseolina	3.17	64.78	2.27	74.78	2.00	77.78	2.48	72.44
F. solani	7.17	20.33	6.50	27.78	6.33	29.67	6.67	25.89
T. harzianum	8.00	11.11	7.00	22.22	6.50	27.78	7.17	20.33
T. viride	8.00	11.11	7.50	16.67	7.00	22.22	7.50	16.67
control	9.00	--	9.00		9.00		9.00	
L.S.D 5%	1.44		1.43		1.49		1.45	

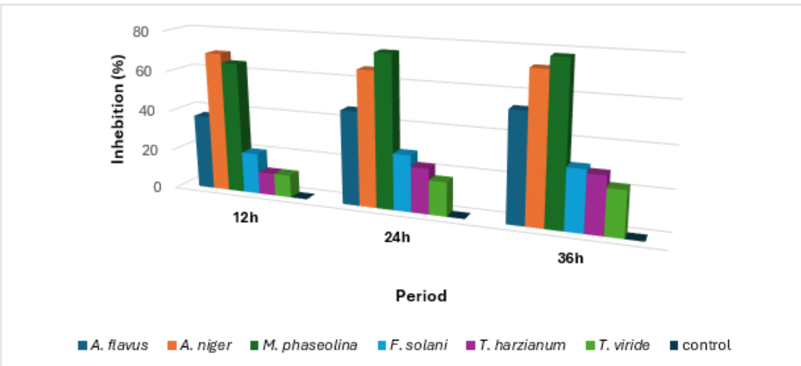

Figure 3. Inhibition (%) of fungal growth diameter after exposure periods of 12, 24 and 36 h to magnetic field (5 mT).

Beginning at the end of the nineteenth century, research on how electromagnetic affects living things increased in the decades that followed as a result of widespread electrification and the spread of communications.

Beretta *et al*., (2019) and Ali *et al*., (2014) reported that MF poles suppressed the growth diameter (cm) of *Fusarium oxysporum* by inhibiting the DNA replication and increasing the metabolic activity, while the MF poles stimulated the growth of other fungi such as *Alternaria alternata, Aspergillus niger* and *Penicillium chrysogenium*. This stimulatory effect may be due to the indicated increase in the metabolic activity of the fungal cell and the increase in the rate of cell DNA replication while the northern pole inhibited the growth of *R. oryzae* compared with control group. Also, Ashnaei *et al*., **(**2024**)** mentioned that exposing *Leptosphaeria maculans* Gol125 and *Leptosphaeria biglobosa* KH36, the causal agents of Phoma stem cancer (blackleg) disease in rapeseed to magnetic fields led to decreasing growth speed over time in the fungal cultures. (Lednev**,** (2001) reported that, weak magnetic field may induce massive changes in the metabolism of cells and altered ion flow through cell membranes and affected the activity of ion channels (Galt *et al*., 1993; KateMelville**,** 2006 and Bokkon**,** 2008) and ion transport in cells (Garcia-Sancho and Javier**,** 2004).

Data in Table (3) show the effect of magnetic field on the activity of the fungicide Rizolex-T after exposure for 12, 24 and 36 h, emergence of radish seed and seed rot% after 7 days from incubation with fungi on water agar under 25±2°C *in vitro*. Results exhibited that the magnetized Rizolex-T had not any harmful effect on radish seed germination with *T. harzianum* or *T. viride* which were 100% for both. Also, it can be noticed the fungicide Rizolex-T was more toxic after exposure to magnetic field for 24 h and prevented seed rot caused by *A. flavus, A. niger* and *F. solani* but in case of the treatment of *M. phaseolina* seed rot % increased to 13.33%. Only the treatment of Rizolex-T exposed to MF for 36 h + *A. flavus* prevented the seed rot%. In case of the treatments infected only with the pathogenic fungi, it can be noticed that seed rot increased in all treatments and the treatment of *M. phaseolina* had the highest value with 80.00%. In this respect, the treatments of non-magnetized fungicide showed that non-magnetized Rizolex-T was more toxic with *F. solani* followed by *A. niger, A. flavus* and *M. phaseolina* with averages of 6.67, 13.33, 20.00 and 40.00%, respectively. The magnetized Rizolex-T was more toxic and resulted in more inhibition rate on *A. flavus, A. niger* and *M. phaseolina* than non-magnetized.

In this respect, data in Table (4) show the effect of magnetic field on the activity of the fungicide Celest after exposure for 12, 24 and 36 h, emergence of radish seed and seed rot% after 7 days from incubation with fungi on water agar under 25±2°C *in vitro*. The same trend with Celest treatment was cleared with magnetized Celest at the three periods + *T. harzianum* and *T. viride* where they had the highest germination seeds with an average of 100% for both. Also, it can be noticed that magnetized Celest for 24 h had the most toxic effect on the pathogenic fungi *A. flavus* which prevented completely the seed rot followed by *M. phaseolina, F. solani* and *A. niger* with averages of 6.67, 6.67 and 13.33%, respectively. The treatments of non-magnetized fungicide showed that the treatment of *A. flavus* had the least seed rot % followed by the treatments of *A. niger, M. phaseolina* and *F. solani* with averages of 13.33, 20.00, 26.67 and 26.67%, respectively. In this respect, the magnetized Celest was more toxic and resulted in more inhibition rate on *A. niger, M. phaseolina* and *F. solani* than non-magnetized.

Table 3. Effect of magnetic field on the activity of Rizolex-T fungicide after exposure for three periods on radish seed germination and seed rot % after seven days from incubation with fungi on water agar under 25± 2 ºC *in vitro* experiment.

Periods (h)	12		24		36		Mean		Infected only		Non-magnetized fungicides	
Parameters Fungi	Seed germination(%)	Seed rot (%)	Seed germination(%)	Seed rot (%)	Seed germination (%)	Seed rot (%)	Seed Germination (%)	Seed rot (%)	Seed Germination (%)	Seed rot (%)	Seed Germination (%)	Seed rot (%)
A. flavus	80.00	20.00	100.00	0.00	100.00	0.00	93.33	6.67	40.00	60.00	80.00	20.00
A. niger	86.67	13.33	100.00	0.00	93.33	6.67	93.33	6.67	33.33	66.67	86.67	13.33
M. phseolina phaseolina	60.00	40.00	86.67	13.33	80.00	20.00	75.56	24.44	20.00	80.00	60.00	40.00
F. solani	93.33	6.67	100.00	0.00	86.67	13.33	93.33	6.67	46.67	53.33	93.33	6.67
T. harzianum	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00
T. viride	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00
LSD 5%	8.89	5.07	3.18	1.81	4.93	2.81	5.24	2.99	20.30	11.57	8.89	5.07

Table 4. Effect of magnetic field on the activity of Celest fungicide after exposure for three periods on radish seed germination and seed rot % after seven days from incubation with fungi on water agar under 25±2 º C *in vitro* experiment.

Periods (h)	12		24		36		Mean		Infected only		Non-magnetized fungicides	
Parameters Fungi	Seed germination (%)	Seed rot (%)	Seed germination (%)	Seed rot (%)	Seed germination (%)	Seed rot (%)	Seed germination (%)	Seed rot (%)	Seed germination (%)	Seed rot (%)	Seed germination (%)	Seed rot (%)
A. flavus	86.67	13.33	100.00	0.00	66.67	33.33	84.44	15.56	40.00	60.00	86.67	13.33
A. niger	80.00	20.00	86.67	13.33	80.00	20.00	82.22	17.78	33.33	66.67	80.00	20.00
M.phaseolina	66.67	33.33	93.33	6.67	66.67	33.33	75.56	24.44	20.00	80.00	73.33	26.67
F. solani	80.00	20.00	93.33	6.67	60.00	40.00	77.78	22.22	46.67	53.33	73.33	26.67
T. harzianum	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00
T. viride	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00
LSD 5%	7.57	4.31	3.18	1.81	10.29	5.87	6.31	3.60	20.30	11.57	7.15	4.08

Data in Table (5) show the effect of magnetic field on the activity of the fungicide Moncut 25% after exposure for 12, 24 and 36 h, emergence of radish seed and seed rot% after 7 days from incubation with fungi on water agar under 25±2°C *in vitro*. The treatments of magnetized Moncut + *T. harzianum* and *T. viride* had the highest seed germination%

as the above two magnetized fungicides (Rizolex-T and Celest) with average of 100% for both. Also, the MF exposure for 24 h had the best effect compared to the other periods (12 and 36 h) and the magnetized Moncut prevented the seed rot caused by *A. niger* and *F. solani* followed by *A. flavus* and *M. phaseolina* with averages of 6.67 and 13.33%, respectively. The magnetized Moncut was more toxic and resulted in more inhibition rate on *A. niger* only than non-magnetized. In case of non-magnetized fungicides, *A. flavus* had the least seed rot% followed by *M. phaseolina, F. solani* and *A. niger* with averages of 13.33, 20.00, 20.00 and 26.67%, respectively.

Generally, from the above three tables (3, 4 and 5) it is clear that in case of magnetized and non-magnetized fungicides, the treatments of *T. harzianum* and *T. viride* had the best germination seed% with 100.00% because they are nonpathogenic fungi and exposed the above three fungicides to MF for 24h had the best toxic effect on the tested pathogenic fungi more than another periods (12 and 36 h).

The effects of magnetic field are usually divided into four different categories (''positive'', ''negative'', ''undefinable'' or ''null'') according to their possible consequences on environmental bioremediation: 1. ''positive'' (+) effects: stimulation of the degradation of contaminants, increase in metabolic activity or in the activity of specific enzymes; 2. ''negative'' (-) effects: reduction of the degradation of pollutants, reduction in metabolic activity; 3. ''undefinable'' (x): modifications in the activity of enzymes that are not involved in the degradative metabolism, modifications in the cell form and the characteristics of the cell wall and its electrostatic charge 4. ''null'' (=): absence of significant effects on the aspects indicated above (Beretta *et al*., 2019 and Allwbawi *et al*., 2019) investigate the degradation of chemical compounds of five pesticides (Bayfidan EC, Bulldock EC, Oberon SC, Galaxy SL and Trayf EC) using the magnetic field interacted with two fungal species *Aspergillus falavus* and *A. terres*. The magnetized Bulldock exhibited more toxicity and a higher inhibition rate on *A. flavus* compared to the non-magnetized variant, while magnetized Bayfidan was more toxic to *A. terres*. The magnetization process is accompanied by various alterations in the chemical and physical properties of water, including elevated dissolved oxygen levels, decreased surface tension, enhanced solubility of solids and electrical conductivity, increased availability of soil nutrients, improved cell membrane permeability, and reduced viscosity relative to normal water. Plant growth and development will benefit from these changes in magnetized water as they will boost plant absorption, speeding up essential processes (Toledo *et al*., 2008).

Greenhouse Experiments:

Results presented in Table (6) show the effect of magnetized both fungicides and sesame seeds cv. Giza 32 (MF + MS) on infection with *M. phaseolina*. The magnetization of them prevented the pre-emergence damping – off followed by MF and NMF treatments with averages of 6.28 and 13.30% at the first season and 6.70 and 13.30% at the second season. The least post emergence damping – off was noticed with (MF + MS) treatment followed by MF and NMF treatments with averages of 3.30, 10.00 and 10.00%, respectively in the first season. The same trend cleared in the second season where (MF + MS), (MF) and (NMF) showed the least post emergence damping – off with averages of 6.70, 13.30 and 16.70%, respectively. At the same time, the treatment (MF + MS) had the least charcoal rot incidence with averages of 6.37 and 10.00% for both seasons, respectively followed by MF and NMF with an average of 13.30% for both in the first season and 13.30 and 16.70% in the second season, respectively.

Table 5. Effect of magnetic field on the activity of moncut 25% fungicide after exposure for three periods and the effect on radish seed germination and seed rot % after seven days from incubation with fungi on water agar under 25±2 ºC *in vitro* experiment.

Periods (h)	12		24		36		Mean		Infected only		Non-magnetized fungicides	
Parameters / Fungi	Seed germination (%)	Seed rot (%)	Seed germination (%)	Seed rot (%)	Seed germination (%)	Seed rot (%)	Seed germination (%)	Seed rot (%)	Seed germination (%)	Seed rot (%)	Seed germination (%)	Seed rot (%)
A. flavus	86.67	13.33	93.33	6.67	66.67	33.33	82.22	17.78	40.00	60.00	86.67	13.33
A. niger	73.33	26.67	100.00	0.00	66.67	33.33	80.00	20.00	33.33	66.67	73.33	26.67
M.phaseolina	80.00	20.00	86.67	13.33	60.00	40.00	75.56	24.44	20.00	80.00	80.00	20.00
F. solani	80.00	20.00	100.00	0.00	60.00	40.00	80.00	20.00	46.67	53.33	80.00	20.00
T. harzianum	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00
T. viride	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00
LSD 5%	6.52	3.72	3.26	1.86	11.21	6.39	6.34	3.61	20.30	11.57	6.52	3.72

Table 6. Effect of magnetized Celest and sesame seeds cv. Giza 32 on infection with *M. phaseolina* under greenhouse conditions during 2022 and 2023 seasons.

Season	1st season				2nd season			
Treatment \ Parameter	Pre-	Post-	Charcoal rot	Healthy	Pre-	Post-	Charcoal rot	Healthy
Magnetized Fungicide (MF)	6.28	10.00	13.30	70.42	6.70	13.30	13.30	66.70
Non-Magnetized Fungicide (NMF)	13.30	10.00	13.30	63.40	13.30	16.70	16.70	53.30
Magnetized Seeds (MS)	16.70	13.30	16.70	53.30	16.28	15.30	20.30	48.12
MF+MS	0.00	3.30	6.37	90.33	0.00	6.70	10.00	83.30
Infested soil only	25.30	20.00	20.00	34.70	30.00	22.50	22.50	25.00
control (un-infested soil)	0.00	0.00	0.00	100.00	0.00	0.00	0.00	100.00
LSD 5%	3.34	2.38	2.42	7.99	3.81	2.65	2.71	8.89

In this respect, (Abd El-Nabi *et al*., 2013) exhibited that the exposure to Dynamic magnetic field decreased the percentage of disease incidence and disease severity of *S. cepivorum* on onion plants. (Tirono *et al*., 2021) reported that treating sesame seeds with magnetic fields from 0.1 mT to 0.3 mT led to earlier emergence time of sprouts and more resistance to *F. oxysporum* wilt attacks. Also, (Ashnaei *et al*., 2024) exhibited that the magnetic field treated rapeseed plants decreased Phoma stem cancer (blackleg) disease by around 6% under greenhouse conditions.

Regarding to data mentioned in Table (7), it is clear that magnetized pathogenic fungi (*A. flavus, A. niger, M. phaseolina* and *F. solani*) had less qualitative protease and amylase activities compared to non-magnetized. In case of exposed *A. niger* treatment, amylase activity did not detect on the medium. In contrast there are no differences with protease and amylase activities between the exposed and unexposed *F. solani*.

Table 7. Effect of magnetic field on Protease and Amylase activities produced from the tested pathogenic fungi (5mTfor 24 h).

Pathogenic fungi / Enzymes activity	*A. flavus*		*A. niger*		*M. phaseolina*		*F. solani*	
	M	NM	M	NM	M	NM	M	NM
Protease	+ +	+ + +	+	+ + +	+	+ + +	+ + +	+ + +
Amylase	+	+ +	−	+	+	+ +	+ +	+ +

M: magnetized, NM: Non-magnetized

− :negative activity, + : moderate activity, + + : good activity, +++ : highest activity.

The magnetic field energy has a significant impact on the characteristic metabolism of organisms; these changes occur in the exchange of ions through the cell membrane and in the movement of cells (Jabir and Sabah 2017**).** Ali *et al.,* **(**2014) reported that *Fusarium oxysporum, Penicillium chrysogenium, Aspergillus niger, Alternaria alternate* and *Rhizopus oryzae* and were influenced by MF energy for 3 days at 28°C and pH 6.5 and amylase and protease activities were significantly increased. Also, (Hashim *et al*., 2016) mentioned that the amylase specific activity of *Fusarium sp.* and *Mucor sp*. was greatly enhanced by the Southern and both Poles treatments, whereas it was significantly lowered by the opposite with *Alternaria* sp. and *Penicillium* sp. compared with the control. On the other hand, the Northern Pole treatment significantly decreased the amylase specific activity of *Alternaria* sp., *Fusarium* sp., and *Penicillium* sp. Many parameters, such as fungal species, temperature, pH, substrate concentration, the presence of an activator or inhibitor, and the various impacts of the northern, southern, and two poles, can alter the activity of the enzyme.

The most reasonable explanation of the decrease of enzyme specific activity (amylase) after exposing the fungi to the Northern magnetic field is attributable to the probable interface of the negative charge of magnetic field with the release of the stimulating effect of (Ca2+). Veerana *et al.,* **(**2022) examined radio-frequency electromagnetic field (RF-EMF) for its possibility to enhance production of an enzyme, α-amylase, in a filamentous fungus, *Aspergillus oryzae*. They reported that activity of α-amylase measured in media were 300%, 180%, and 150% in the RF-EMF exposed (10 min) sample than control (no RF-EMF) during incubation (16, 24, and 48 h after RF-EMF exposure). The elevation of the Ca2+ level may have acted as a secondary signal that leads to the activation of pathways involved in intracellular gene expression and extracellular secretion of α-amylase.

(Jabir and Hashim 2017) mentioned that Northern pole significantly decreased the protease specific activity of *Alternaria* sp., *Aspergillus niger*, and *Penicillium sp*., the Southern pole and both poles significantly decreased protease activity of *Alternaria* sp. and *Penicillium* sp. (Sumardi *et al*., 2018) studied the effect of 0.2mT magnetic field exposure treatment for 10 minutes toward medium components to the production of protease in *Bacillus* sp. and they reported that qualitative Proteolytic Activity test on *Bacillus* sp. indicated that the bacteria were able to produce the enzyme more than the unexposed media.

Moreover, regarding the data in Table (8) the magnetized both of the fungicide and sesame seeds (MF + MS) increased peroxidase activity compared to infested soil + nonmagnetized seeds and uninfested soil + nonmagnetized seeds treatments. (MF + MS) treatment had the highest value followed by MS, MF and NMF with averages of 1.85, 1.62, 1.52 and 1.42, respectively. On the other hand, the same trend cleared with total phenol content where the same arrangement of the previous treatments showed the averages 10.17, 8.20, 7.23 and 6.67, respectively.

Table 8. Effect of magnetized Celest fungicide and sesame seeds cv. Giza 32 on the activities of peroxidase and total phenol in leaf extracts of sesame plants (as optical density/minute/g fresh weight).

Treatment	2nd season	
	Peroxidase	Total phenol
Magnetized fungicide (MF)	1.52	7.23
Non- magnetized fungicide (NMF)	1.42	6.67
Magnetized seeds (MS)	1.62	8.20
MF+MS	1.85	10.17
Infected soil	0.73	5.47
control (non-infested soil)	1.05	6.47
LSD 5%	0.14	0.55

(Gang *et al*., 1994) mentioned that treating wheat seedlings with magnetic fields had increased the activity of Peroxidase (POX). Also, (Kursevich and Travkin 1973 and Atak *et al*., (2003) found that magnetic field treatment had elevated catalase, peroxidase, superoxide dismutase and glutathione reductase to the highest levels in barley seedlings. (Atak *et al*., 2007) revealed that peroxidase activity significantly increased when soybean shoot tips were put into petri dishes and exposed to a magnetic field for a period of 2.2 and 19.8 s at a magnetic flux of 2.9-4.6 mT. In this respect, (Abdolmaleki *et al*., 2007) found that suspension-cultured tobacco cells exposed to static magnetic field at a magnetic flux of 10 and 30 mT for 5 h/day caused an increase in the activity of peroxidase activity. In this respect, (Saletnik *et al*., 2022) exhibited that MFs caused high activity of antioxidant enzymes depending on the intensity of the MF, application time, and type of plant.

In *Artemisia sieberi* seedlings, magnetic field priming changed total phenolic content as well as antioxidant enzymatic activities (Azimian and Roshandel**,** 2015**).** Masahi-Chaharsoughi *et al.,* **(**2016) reported that the total phenol content and antioxidant activity in comparison with control samples had Significantly increased in *Portulaca oleracea* treated with different electromagnetic field (1200, 1800, 2400, 3600 G at 20 min). Also, (Mansourkhaki *et al*., 2019) showed that SMF increased markedly total phenolic and flavonoid compounds in magnetized *Silybum marianum* seedlings. (Afzal *et al*., 2023) reported that when a magnetic solution is applied to plants, it activates key enzymes of phenolic metabolism. Currently, the positive effect of SMF on the quantitative and qualitative values of phenolics may be dependent upon the possible modulation of the PAL enzyme by SMF seed treatment.

The correlation coefficient values between pre- and post - emergence damping-off from one hand and peroxidase activity and total phenol content from another hand in the sesame plants are illustrated in Figure (4). The results in (Fig. 4A and B) showed that the pre-emergence damping-off strongly correlated and moderate correlated with peroxidase activity and total phenol contents of sesame plants, recording r = - 0.85 and - 0.81, respectively. Also, strong correlation was cleared with the post-emergence damping-off and peroxidase activity and total phenol contents, recording r = - 0.89 and - 0.85, respectively (Fig. 4 C and D). In case of infected sesame plants with charcoal rot it can be noticed that the peroxidase activity and the total phenol contents had moderate correlation with infection recording r = - 0.81 and -0.84, respectively (Fig. 4E and F) in contrast the non-infected sesame plants had low correlation with peroxidase activity and total phenol contents, recording r = 0.62 and 0.61, respectively (Fig. 4 G and H).

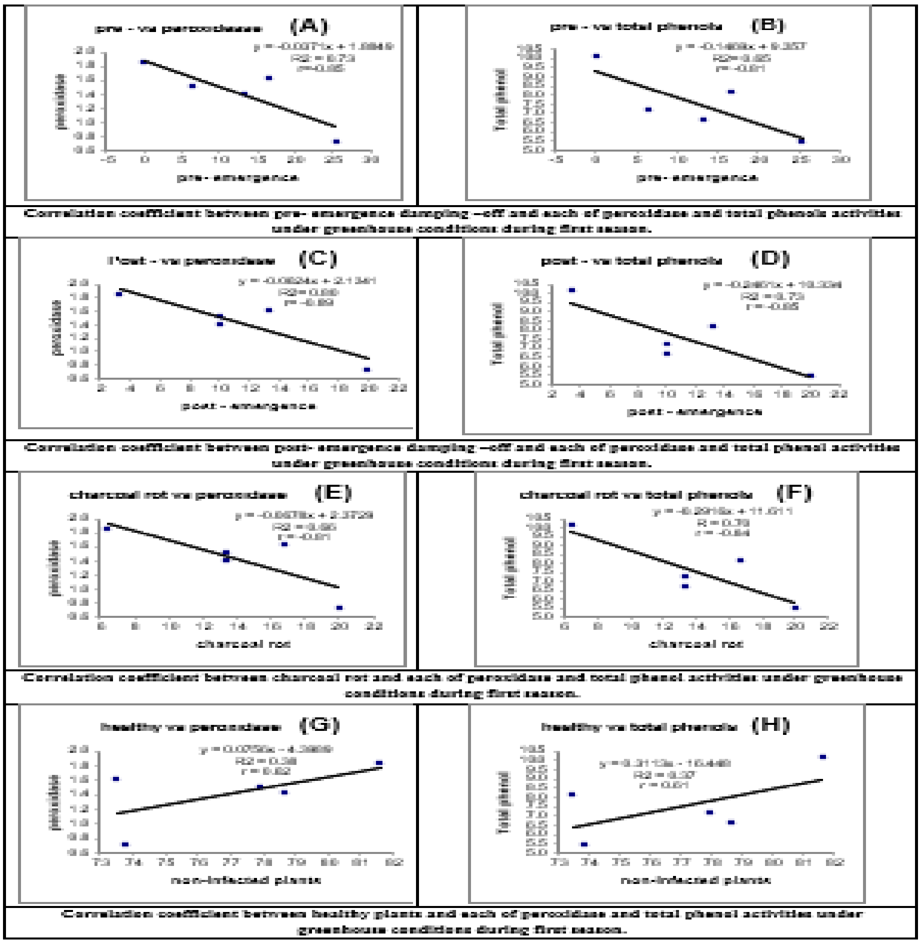

Fig. 4. Correlation coefficient between pre-, post-emergence damping – off and charcoal rot disease and each of peroxidase activity and total phenol contents.

These results are in harmony with that mentioned by (Khalifa *et al*., 2007) who reported that there is a correlation between induced resistance of charcoal rot on sunflower plants and increasing the activity of peroxidase enzyme and phenol compounds content. The same trend mentioned by Mohammadi and Kzami **(**2002) with wheat heads, (Li *et al*., 2003) with maize stalk rot and (Fatoh *et al*., 2024) with maize charcoal rot who found that resistance to these diseases is significantly correlated with the enzymatic activities of peroxidase and polyphenol oxidase. Also, (Shoaib *et al*., 2022) stated that a reduction in the disease of charcoal disease in mung bean may result in greater photosynthetic pigment and more production of effective antioxidant defense enzymes (e.g., SOD, CAT, POX, and PPO) in host plants.

REFRENCES

Abd El-Nabi; Heba, M. and Hafez, M. (2013). Effect of magnetic field on virulence and morphological changes of *Sclerotinum cepivorum*. J. Plant Prot. and Path., Mansoura Univ. 4 (1): 41-47.

Abdelhameed, A.E. (2014). Growth rate inhibition of some spoilage fungi of food by magnetic field. Misr J. Ag. Eng., 31 (1): 299-308.

Abdolmaleki, P.; Ghanati, F.; Sahebjamei, H. and Sarvestani, A.S. (2007). Peroxidase activity, lignification and promotion of cell death in tobacco cells exposed to static magnetic field. Environ. 27:435–440.

Afzal, B.; Nisa, Z.U.; Bashir, R.; Ali, N.; Mahmood, S.; Azeem, M.; Batool, F.; Wahid, A.; Iqbal, M.; Alsahli, A.A. and Kaushik, P. (2023). Magnetic seed treatment modulates phenolic and fatty acid metabolism of sunflower underwater scarcity. Agronomy. 13, 2094. https://doi.org/10.3390/ agronomy 13082094.

Ali, Z.A.; Yahya, A.G.I. and Jabir, A.W.Sh. (2014). The Effect of static magnetic field on growth and biochemical indices of five fungal genera. J. Biotech. Res. Cent. 8(3):28 – 26.

Allwbawi, S.A.Z.J. and Alshafiee, A.K.A.Z. (2018). Effect of the magnetic field on the interaction with two types of fungus *Fusarium* sp. and the fungus resistance biogenic *Trichoderma harzianum* in the analysis of some chemical pesticides. Karbalaa Sieance Magazine Agric. Third Sic. Conference.

Allwbawi, S.A.Z.J.; Alwan, S.L.; Mutlag, N.H.; Alshafiee, A.K.A.Z. and Sabboree, H.R. (2019). Effect of the magnetic field interacted with two *Aspergillus* Species in degradation of some chemical pesticides. J. Engin. Appl. Sci. 14 (7): 10131-10136.

Amin, M.M. and Abd-Elbaky, A.A. (2024). Impact of *Streptomyces* on sesame plants under *Macrophomina phaseolina* infestation. Egyptian Journal of Biological Pest Control. 34:38. (1-6).

AOAC (1985). Official Methods of Analysis, 12th ed. Association of Official Analytical Chemists, Washington, D.C., PP. 376-384.

Ashnaei, S.P.; Sadeghi, R.; Hosseinian, L.; Shafaeizadeh, A.; Zeinalipour, M.; Keshvari, H.; Imanzadeh, M. and Bahmanabadi M. (2024). Evaluation of the effect of magnetic field on rapeseed growth and the causal agent of blackleg disease, *Phoma lingam*. J. of Biotech., Computational Biology and Bionanotechnology. 105 (2): 149-158.

Atak, Ç.; Çelik, Ö.; Olgun, A.; Alikamanoğlu, S. and Rzakoulieva, A. (2007). Effect of magnetic field on peroxidase activitiesof soybean tissue culture. Biotechnol. & biotechnol. EQ. 21/2007/2: 166-171.

Atak, C.; Emiroglu, O.; Alikamanogku, S. and Rzakoulieva, A. (2003). Stimulation of regeneration by magnetic field in soybean (*Glycine max* L. Merril) tissue cultures. J. Cell. Mol. Biol. 2: 113-119.

Azimian, F. and Roshandel, P. (2015). Magnetic field effects on total phenolic content and antioxidant activity in *Artemisia sieberi* under salinity. Indian J. Plant Physiol. 20: 264–270.

Beretta, G.; Mastorgio, A.F.; Pedrali, L.; Saponaro, S. and Sezenna, E. (2019). The effects of electric, magnetic and electromagnetic fields on microorganisms in the perspective of bioremediation. Rev. Environ. Sci. Biotechnol. 18:29-75.

Bokkon, I.K. (2008). Phosphene phenomenon, A new concept. J. Biophy. Res. 92: 168-174.

Da Silva, M.A.; Santos,C.; Pérez-Nevado,F.; Lima, N. and Bentes, J.L.da S. (2021). Enzymatic activity and process of initial infection of guarana plant (*Paullinia cupana*) by pathogenic and endophytic strains of *Colletotrichum guaranicola.* Rev. Fitotec. Mex. 44 (1): 67-75.

De Souza, A.; Garcia, D.; Sueiro, L.; Gilart, F.; Porras, E. and Licea, L. (2006). Pre-sawing magnetic treatments of tomato seeds increase the growth and yield of plants. Bioelectromag. 27: 247-257.

El-Saidy, D.D.M.S; Mahmoud, S.H.; ElGarhy, M.A. and Tonsy, H.D. (2009). Nutrition evaluation of sesame seed meal, *Sesamum indicum* (L.) as alternative protein source in diets of juvenile mono-sex Nile tilapia (*Oreochromis niloticus*). Egypt. J. Aquat. Biol. & Fish., 13(1): 93-106

Fatoh, H.M.; Eid, H.T.; Kandil, H.B.A.; Saleh, R.A.; Ali, E.A.E. and Amer, M.A. (2024). Evaluation of different biological treatments on control of charcoal-rot incidence on *Zea mays* caused by *Macrophomina phaseolina.* Egypt J. Phytopathol. 52(2): 69-90.

Galt, S.; Sandblom, J.; Hamnerius, Y.; Hjerik, P.; Saalman, E. and Nardon, B. (1993). Experimental search for combined AC, DC magnetic field effects. Bioelectromagnetics. 14: 315–327.

Gang, X.; Zhi-Dong and F., Ling, J. (1994) Acta Botanica. Sinica, 36:113-118.

Garcia-Sancho, J. and Javier, P. (2004). Effects of extremely low frequency electromagnetic fields on ion transport in several cells. Bioenergetics. 15: 6.

Hammod, S.A. (1989). Studies about *Mauginiella scattae* cav. pathogenic fungi to date palm. Master of Science, Basraa Univ. Science Univ. 140 pp.

Hankin, L. and Anagnostakis, S.L. (1975). The use of solid media for detection of enzyme production by fungi. Mycologia. 67:597–607.

Hashim, Marwa, S.; Yahya, A.I. and Jabir, A. Sh. (2016). The effect of static magnetic field on the production of amylase enzyme under solid state fermentations from five different fungal genera. World Journal of Pharmaceutical Research. 5 (5). DOI: 10.20959/wjpr20165-6142. https://doi.org/10.3390/molecules27185823.

Jabir, A.Sh. and Hashim M.S. (2017). Effect of static magnetic field on protease produced by five fungal isolates using solid state fermentation. Int. J. Adv. Res. 5(6): 2238-2245.

KateMelville, B.C. (2006). Magnetic bacteria maintain their mystery. Naval, J. Med. Laboratory Res. 8:312-315.

Khalifa, M.M.A.; Eetmad, E.I. Draz and Ibrahim M.M.A. (2007). Charcoal rot of sunflower in Egypt: Performance of some various control measures on disease incidence and seed yield production. Egypt. J. App. Sci. 22 (8B): 315-330.

Kursevich, N.V. and Travkin, M.P. (1973). Effects of magnetic fields with different intensities on some enzymes activities in barley seedlings. In: Effects of Natural and Weak Artificial Magnetic Fields on Biological Objects. Belgorod Teacher's Training College Publishing Co. Belgorod, 102–104.

Lednev, V.V. (2001). Possible mechanism for the influence of weak magnetic fields on biological systems. Bioelectromagnetics. 12: 71-75.

Li, Y.L.; Long, S.S.; Guo, J.Z., Zhang; Y.H., Li Q. and Wang, W. (2003). Changes of activities of PAL and POD and bands of POD isozyme of susceptible and resistant corn infected with *Fusarium graminearum*. Acta Botanica Boreali-occidentalia Sinica, 23(11): 1927-1931.

Machado, R.; Pinho, D.B.; Soares, D.J.; Gomes, A.A.M. and Pereira, O.L. (2019). Bayesian analyses of five gene regions reveal a new phylogenetic species of *Macrophomina* associated with charcoal rot on oilseed crops in Brazil. Eur. J. Plant Pathol. 153:89-100.

Mahdy, E.E., El- Shimy, A.A., Sayed, M.A., Mahmoud, A.F., Pedigree, A.S. (2023). Selection in improving seed yield and tolerance of sesame to *Macrophomina* *phaseolina* (Tassi) Goid. Egypt. J. Agron., Vol. 45 (2): 31- 44.

Mansourkhaki, M.; Hassanpour, H. and Hekmati, M. (2019). Effect of static magnetic field on growth factors, antioxidant activity and anatomical responses of *Silybum marianum* seedlings. J. Plant Process and Function, 7(28): 9-15.

Masahi-Chaharsoughi, S.; Leila, A. and Maryam, K. (2016). Effects of electromagnetic fields on seed germination and weight, phenol and flavonoid content and antioxidant system of Portulaca oleracea. Adv. Biores. 7 (3): 100-108.

Mohammadi, M. and Kzami, H. (2002). Changes in Peroxidase and Polyphenol Activity in Susceptible and Resistant Wheat Heads Inoculated with *Fusarium graminearum* and Induced Resistance. Plant Sci. 162:(491-498). doi:10.1016/S0168-9452(01)00538-6.

Pal, N. (2005). The effect of low inductivity static magnetized field on some plant pathogen fungi. J. Central European Agric., 6(2): 167-171.

Pentoś, K.; Wondołowska-Grabowska, A.; Gajda, G.; Babij, M.; Chohura, P.; Zaleski, A. and Gajda, D. (2022). The effect on the germination vigor of cucumber seeds after receiving magnetic field treatment pre-sowing. Appl. Sci. 12(11): 5490.

Radhakrishnan, R. (2019). Magnetic field regulates plant functions, growth and enhances tolerance against environmental stresses. Physiol. Mol. Biol. Plants. 25(5):1107-1119.

Saletnik, B.; Saletnik, A.; Słysz, E.; Zaguła, G.; Bajcar, M.; Puchalska-Sarna, A. and Puchalski, C. (2022). The Static Magnetic Field Regulates the Structure, Biochemical Activity, and Gene Expression of Plants. Molecules, 27, 5823.

Sarath, G.; De La Motte, R.S. and Wagner, F.W. (1989). Protease assay methods. In: Beynon RJ, Bonde JS, editors. Proteolytics enzymes: a pratical approach. Oxford, UK: University Press. p. 25–54.

Sarraf, M.; Deamici, K.M.; Taimourya, H.; Islam, M.; Kataria, S.; Raipuria, R.K.; Abdi, G.h. and Brestic, M. (2021). Effect of Magnetopriming on Photosynthetic Performance of Plants. Int. J. Mol. Sci. 22: 9353.

Sarraf, M.; Kataria, S.; Taimourya, H.; Santos, L.O.; Menegatti, R.D.; Jain, M. and Liu, S. (2020). Magnetic field (MF) applications in plants: An overview. Plants 9(9): 1139.

Shoaib, A.; Khan, K.A.; Awan, Z.A.; Jan B.L. and Kaushik, P. (2022) Integrated management of charcoal rot disease in susceptible genotypes of mung bean with soil application of micronutrient zinc and green manure (prickly sesban). Front. Microbiol. 13:(1-13). https://doi.org/10.3389/fmicb.2022.899224.

Sumardi, S.; Rochmah, A.; Bambang, I. and Ajeng, P. (2018). The effect of magnetic field exposure on medium to protease production by *Bacillus* sp. Biovaentia Biological, Research Journal. 4(2). 10.24233/BIOV.4.2.2018.105.

Thimmaiah, S.K. (1999). Standard Methods of Biochemical Analysis. Kalyani Publishers. New Delhi.

Tirono, M.; Hananto, F.S.; Suhariningsih, S. and Aini, V.Q. (2021). An effective dose of magnetic field to increase sesame plant growth and its resistance to *Fusarium oxysporum* wilt. Inter. J. Des. Nat. Ecody. 16(3): 285-291.

Toledo, E.J., Ramalho, T.C. and Magriotis, Z.M. (2008). Influence of magnetic field on physical-chemical properties of the liquid water: Insights from experimental and theoretical models. J. Mol. Struct., 888: 409-415.

Veerana, M.; Yu, N.; Bae, S.; Kim, I.; Kim, E.; Ketya, W; Lee, H.; Kim N. and N. Park, G. (2022). Enhancement of fungal enzyme production by radio-frequency electromagnetic fields. *J. Fungi*. 8, 1187.

Xuesong, Z.; Chaofeng, Sh.; Rong, H. and Rongguang, Shi. (2021). Evolution and efficiency assessment of pesticide and fertiliser inputs to cultivated land in China. Int. J. Environ Res Public Health. .18(7): 3771.

فعالية المجال المغناطيسي على فاعلية بعض مبيدات الفطريات الكيميائية على بعض الفطريات المسببة لمرضي الذبول والعفن الفحمي على نباتات السمسم (*Sesamum indicum* L.)

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الملخص

تم دراسة فعالية المجال المغناطيسي (MF) (٥ مللي تسلا ١٢ و٢٤ و٣٦ ساعة) على نمو فطريات *Aspergillus A. flavus*، و*Aspergillus niger*، و *Macrophomina phaseolina*، و*Fusarium solani*، و*Trichoderma* harzianum، وTrichoderma viride في المختبر. كان *A. niger* الأكثر حساسية للمجال المغناطيسي لمدة ١٢ ساعة، حيث بلغ معدل تثبيط النمو ٦٦,٢٢%، يليه *M. phaseolina*، و *A. flavus* و*F. Solani* و *T. harzianum* و *T. viride*. كما ازداد معدل التثبيط مع زيادة فترة التعرض حتى ٣٦ ساعة. كان نشاط إنزيمات البروتييز والأميليز النوعي للفطريات الممرضة الممغنطة أقل مقارنةً بالفطريات غير الممغنطة. ولم يُكتشف نشاط الأميليز في وسط *A. niger* المُعرّض. تمت دراسة تأثير مبيدات "مونكت٢٥٪" و "سيليست" و "ريزولكس-تي ٥٠٪" الممغنطة (MF) وبذور السمسم صنف جيزة ٣٢ (MS) على الإصابة بفطر *M. phaseolina* تحت ظروف الدفيئة لموسمين (٢٠٢٢ و٢٠٢٣). منعت (MF + MS) الذبول قبل الإنبات متبوعًا بمعاملات MF وNMF لكلا الموسمين. لوحظ أقل معدل لكل من الذبول بعد الإنبات والعفن الفحمي مع معاملة (MF+MS). كان لدى (MF+MS) أعلى قيم لنشاط البيروكسيديز (PX) ومحتوى الفينول الكلي (TPC). ارتبط الذبول قبل الإنبات عكسياً بقوة مع (PX) و(TPC) مسجلاً -٠,٨٥ و -٠,٨١ ، على التوالي. تم توضيح الارتباط القوي مع الذبول بعد الإنبات و (PX) و (TPC)، مسجلاً $r = -0.89$ و- ٠,٨٥ على التوالي. كان لـ (PX) و (TPC) ارتباط معتدل مع تسجيل حدوث المرض -٠,٨١ و -٠,٨٤ على التوالي.