EVALUATION OF SOME ISOLATED BACTERIA FROM SOIL ON BIODEGRADATION OF MALATHION AND CYFLUTHRIN

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ABSTRACT

The intensive use of the insecticides resulted in dangerous effects on environmental components. This study aimed to evaluate the role of bacteria isolated from soil on the degradation of malathion and cyfluthrin. In this study, 230 isolates were obtained from various sources of Egyptian soil contaminated with pesticides. On a solid medium, the isolates were grown with 100 ppm malathion and cyfluthrin insecticides. Thirty-nine bacterial isolates tolerated the tested pesticides, and thirteen grew rapidly. The thirteen isolates were grown in a broth medium with the tested insecticide. According to optical density, six isolates had high density (high growth). Three isolates with the codes S.MC.2, S.MC.12, and S.MC.16 were chosen for malathion degradation, and three isolates with the codes S.M3+M3, S.MC.6, and S.Z.14 were chosen for cyfluthrin degradation. The selected isolates appeared to be able to tolerate high concentrations of malathion (855 & 1425 ppm) and cyfluthrin (400 & 800 ppm). Compared with control, the most efficient isolates were S.MC.16 and S.M3+M3, which had the lowest percentage of cell dry weight reduction after growing in the presence of the above-mentioned insecticide concentrations compared to control.

Keywords: Bacterial isolates, bacteria, malathion, cyfluthrin, biodegradation.

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INTRODUCTION

Pesticides are any material or combination of materials used to eradicate harmful pests such as nematodes, other arthropods outside insects, and vertebrates that threaten our food supply, health, or comfort, as well as weeds and other plant harmful organisms. Specifically, the term "pesticide" describes substances that interfere with the biological functions of creatures that are regarded as pests, such as weeds, mold, fungi, insects, or toxic plants. In most crop production locations, pesticides are frequently used to reduce insect infestation, protect crops from potential yield losses, and lower the quality of the final output **Damalas (2009).** The application of pesticides may cause adverse effects among the different forms of life and the ecosystems; this will depend on the sensibility grade of the organisms and the pesticides. Roughly, 90% of pesticides used in agriculture end up in the environmental components instead of reaching their intended targets. They are therefore frequently found in the air, surface and groundwater, sediment, soil, vegetables, and to a lesser degree in food. Furthermore, a great deal of soil-applied pesticides was purposefully added to the soil environment to control soil-borne pathogens and pests, which causes an unacceptable buildup of their metabolites and residues in the soil **(Gamón *et al.*, 2003; Shalaby and Abdou 2010).**

Soil contamination with insecticides affects soil microbial communities, bacterial diversity, nitrogen transformations, soil animals, and soil enzymes, all of which have an impact on agricultural ecosystems (**Srinivasulu and Ortiz (2017); Satapute *et al*. 2019).** Thus, crop quality and food safety are directly linked to agricultural soil quality, and these factors are linked to human health **(Hathout *et al*., 2022)**.

Insecticide-degrading microbes can naturally exist or be intentionally introduced into the environment. These microorganisms feed on and utilize pesticides as both a source of food and energy. Fungi, bacteria, and yeasts are among the microbial species responsible for breaking down many pesticides found in **soil. (Książek and Szpyrka 2022).** Pesticides undergo biodegradation processes in which microorganisms convert them into degradation products or totally mineralize them. These organisms employ the polluting compounds as

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fuel for their metabolic operations. Enzymes that affect and catalyze the biochemical reactions, such as oxygenases, peroxidases, and hydrolases, play crucial parts in the biotransformation mechanisms. There are three stages to the pesticide breakdown process **(Raffa and Chiampo 2021).** This can be summed up as follows: Phase 1: Pesticides undergo oxidation, reduction, or hydrolysis processes to change into more water-soluble and less dangerous compounds, Phase 2: Sugars and amino acids, which are more water soluble and less poisonous, are produced from the Phase 1 components and Phase 3: the transformation of the Phase 2 metabolites into secondary conjugates that are less harmful. Bacteria and fungi are the microorganisms that cause the degradation process; they might produce extracellular or intracellular enzymes.

The current study aimed to isolate local bacterial isolates capable of degrading some insecticides in Egyptian soil.

MATERIALS AND METHODS

Samples collection

Six samples were collected from different environmental sources (clay soil, sandy soil, and another with added compost in Qalyubia and Ismailia governorates, from cultivated soil crops of cabbage, corn, potatoes, mangoes, pears, and figs. The source of insulation (soil) was taken from a depth of 15-20 cm after removing debris from the soil surface. Each sample was taken in a sterile bag and kept at 4°C in an ice box for 2–6 hours before being transported to the lab.

Insecticide used

Pyrethroid insecticide:

Trade Name: (Cyflo Roach)

Common Name: Cyfluthrin 10% EC (EC: Emulsifiable Concentrate)

Organophosphorus insecticide:

Trade Name: (Malason/ Extra, Malathen**)**

Common Name: Malathion 57% EC (EC: Emulsifiable Concentrate)

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(Fig. 1 a and b, respectively) obtained from the Pesticide Residue Analysis Laboratory in Food at the Toxicity Unit, Department of Plant Protection, Faculty of Agriculture, Ain Shams University, Cairo, Egypt.

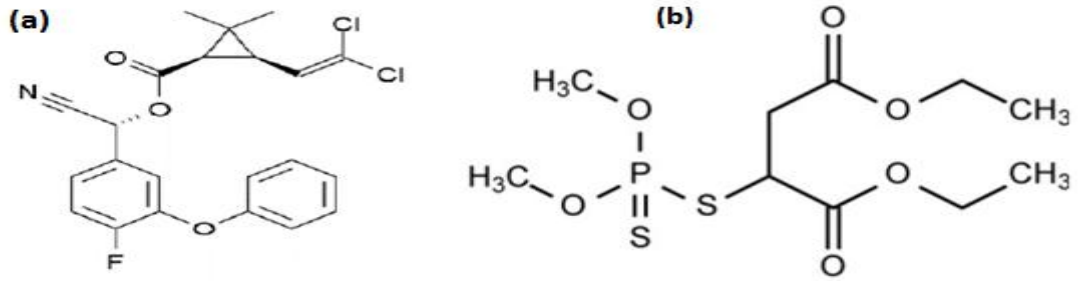

Fig. (1): Structure of (a) cyfluthrin 10% EC and (b) malathion 57% EC.

Media used

Medium (1): Nutrient agar medium **Difco Manual (1984)** was used to isolate, preserve, and maintain bacteria. It has the following composition (g/l): Beef extract, 3; Peptone, 5; Agar-agar, 20 and adjusted to pH 7.

Medium (2): Nutrient broth medium **Difco Manual (1984)** was used for quantitative and qualitative estimation of insecticides removing bacteria. It is the same as previously shown without adding agar.

All experiments were conducted in the microbiology laboratory, Faculty of Agriculture, Ain Shams University, Cairo, Egypt.

Isolation of insecticide degrading microorganisms from soil

Ten grams of representative soil specimens were suspended in 90 ml of sterile tap water and shaken well for 10 min. Serial dilutions up to 10^{-7} (dilution) of each soil sample were prepared using sterilized water. Suitable dilutions were plated (in triplicates) on nutrient agar medium. The poured plates were incubated at 30°C for 5 days. Developed colonies were picked, purified, and preserved at 5°C on an agar slant for further studies **(Asamba *et al.*, 2022).**

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Maintenance of the cultures

Stock culture slants were maintained at 5°C on preservation medium (Nutrient agar medium) after incubation at 30°C for 24-48 h.

Preparation of standard inoculum

The bacterial standard inoculum was prepared by inoculating of a 250 conical flask containing 50 ml of nutrient broth with a loop of the tested culture. The inoculated flasks were incubated on a rotary shaker at 150 rpm for 24h at 30°C. The content of these flasks was used as standard inoculum, in which 1 ml contained 2.1×10^5 colony forming units (CFU)/ml.

Screening for the most efficient bacterial isolates on the biodegradation of the tested insecticides

- **On agar plates as qualitative determination**

All the obtained isolates were detected on 100 ml melted nutrient agar medium supplemented with 50 µl of each of the two insecticides mentioned above in a 250 ml flask using the streak method **Sharma *et al.* (2023**). The flasks were stirred well to complete the homogeneity of the insecticides with the liquefied agar feeder medium). Then, pour the medium into a Petri dish and leave it solid, then inoculate microbes on the medium. Then, incubate the plates in a state for 5 days at 30°C. Developed colonies (insecticide-resistant microorganisms) were picked, purified, and preserved at 5°C on an agar slant for further studies.

In broth medium as quantitative determination

The plugged Erlenmeyer flasks (250 ml) containing 50 ml of nutrient broth medium supplemented with the tested insecticides at a concentration of 100 ppm malathion 57% EC (570 mg/L) and cyfluthrin 10% EC (100 mg/L) of the medium were applied separately. These flasks were inoculated with 2% standard inoculum for the selected isolates and incubated at 30°C on a rotary shaker (150 rpm) for 7 days. At the end of the incubation period, samples (10 ml) were taken from the bacterial growth cultures. The bacterial growth

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was assayed as optical density (O.D) using a UV-Spectrophotometer (T60 UV- VIS Spectrophotometer Quick install Guide) at 620 nm **(Sharma *et al.*, 2023).**

Effect of the tested insecticides on the growth of the selected bacterial isolates

The tested insecticides were used at different concentrations ranging from 855 to 1425 ppm for malathion 57% EC, and 400 and 800 ppm for cyfluthrin 10% EC of the medium and were tested as qualitative and quantitative determination for selecting the most efficient isolates.

Batch experiments were carried out in plugged Erlenmeyer flasks (250 ml) containing 50 ml of nutrient agar and broth medium supplemented with a range of insecticide concentrations:

0, 855, and 1425 ppm for malathion 57% EC and 0, 400, and 800 ppm for cyfluthrin 10% EC of the medium were applied separately to give different concentrations of malathion and cyfluthrin, respectively. The flasks were inoculated with 2% standard inoculum for the tested isolates and incubated at 30°C on a rotary shaker (150 rpm) for 15 days. At the end of the incubation period, biomass determination cells from samples (10 ml) were taken from the bacterial growth cultures broth and centrifugated at 6000 rpm for 10 min using centrifuge (PRO-HOSPITAL.8). The pellets were taken and washed with distilled water about three times and dried for 24 h at 100 °C to determine the cell dry weight **(El-Sawah *et al.*, 2008).**

Statistical analysis

The data were statistically analyzed using IBM SPSS® Statistics software (2018) on the premise of Duncan's multiple range test at the 5% level. All data were repeated three times.

RESULTS AND DISCUSSION

Isolation of insecticide degrading microorganisms from soil

Two hundred and thirty bacterial and fungal isolates were isolated from different soil samples on nutrient agar medium from the Egyptian lands. Results represented in Fig. (2) showed that one hundred and seventy-three isolates were collected from Qalyubia

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government, and fifty-seven isolates were obtained from the Ismailia government, respectively.

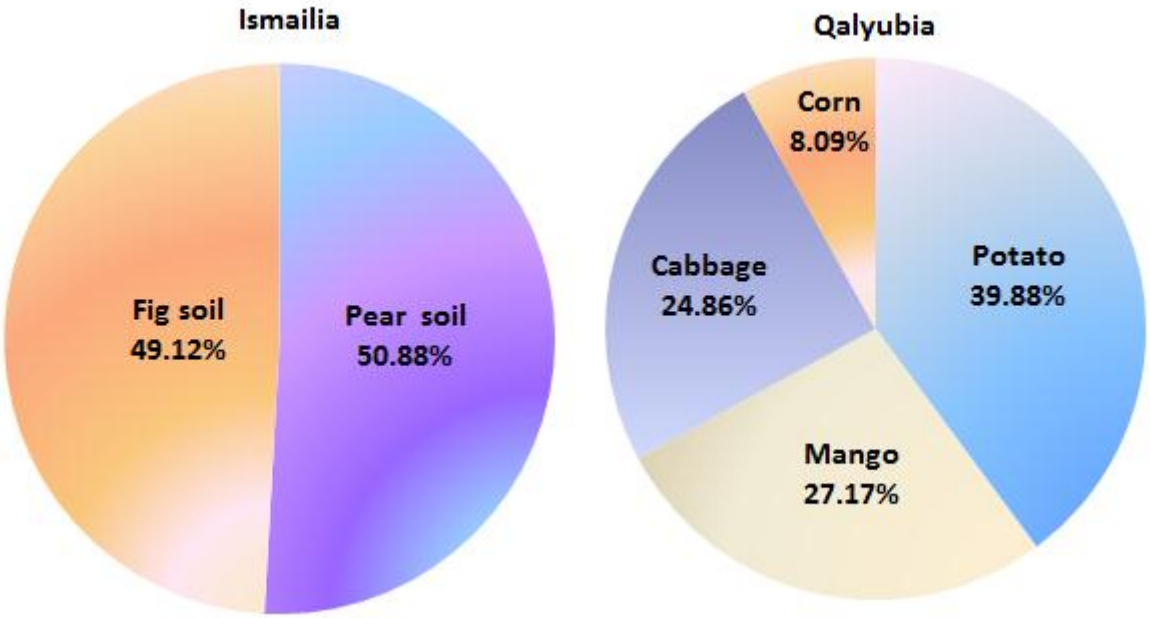

Fig. (2): Number and distribution percentage of microbial isolates obtained from different sources

The results also showed the isolation number and the distribution percentage in the samples collected from Qalyubia Governorate from potato plant cultivated soil (PO), which amounted to 39.88% (69 isolates), followed by isolates obtained from mango plant-grown soil (MC-M), from cabbage cultivated soil (K-C-KC), and from Corn cultivated soil (Z), which were 27.17% (47 isolates), 24.86% (43 isolates), and 8.09% (14 isolates), respectively. Whereas, from Ismailia governorate of pear cultivated soil, which amounted to 50.88% (29 isolates), followed by isolates obtained from soil planted with Fig plant (28 isolates with 49.12 %). In the same trend, **Aziz *et al*. (2014)** gathered agricultural soil samples from various locations within the Beni-Suef Governorate, Egypt, and separated isolates on nutrient agar supplemented with malathion. They found that from twelve isolates, four were to be *Pseudomonas aeruginosa,* two were *Bacillus* species and the remaining

isolates were eliminated. Also, **Saafan *et al*. (2016)** came across those eighteen bacterial isolates on MSM agar medium, which were isolated from 36 samples of wastewater, agricultural drainage water, and soil from various locations in Beni-Suef Governorate, Egypt, were able to grow in the presence of malathion (100 mg/L). While **Asamba *et al.* (2022)** selected four isolates (*Lysinibacillus sp. Stenotrophomonas maltophilia*, *Pseudomonas putida*, and *Achromobacter insuavis*) among the eighteen isolates found on nutritional agar medium treated with pesticide that were isolated from agricultural soil samples in Takorina (chlorpyrifos 55%EC) at 30°C for 7 days. So, **Mehta *et al.* (2021)** collected eleven soil samples from the Himachal region of India, and fifty-two microbial isolates were isolated on nutrient agar, MSM, and MacConkey agar plates medium supplemented with an insecticide (malathion and chlorpyrifos). Thirty-seven isolates showed growth on these media, but only one isolate was chosen as the most effective, which was defined as *Kocuria assamensis* at 2.7%.

Screening for the most efficient biodegradation bacterial isolates on different concentrations of the tested insecticides

- **Qualitative determination on solid medium in the presence of the tested insecticides**

The basic test of insecticide cracking by microbial isolates that can grow in nutrient agar medium after five days of incubation. Bacterial isolates were grown in the presence of insecticides (malathion and cyfluthrin). In Fig. (3), the results showed the number distribution of bacterial isolates in the presence of insecticides. It was observed that out of two hundred and thirty isolates, only nine and thirty isolates were able to grow in the presence of insecticides malathion and cyfluthrin, respectively. Data in Table (1) demonstrated that 39 bacterial isolates were capable of growing in the presence of the tested insecticide and showed positive results with signs from (+) to (+++) according to the intensity of growth from very low to high. Among 39 isolates, 30 bacterial isolates (33.3%) had a high insecticide tolerance, which gave a high growth intensity with sign (+++). Whereas nine and 17 bacterial isolates out of 39 gave a moderate and scant growth intensity with sign (++) and (+), respectively.

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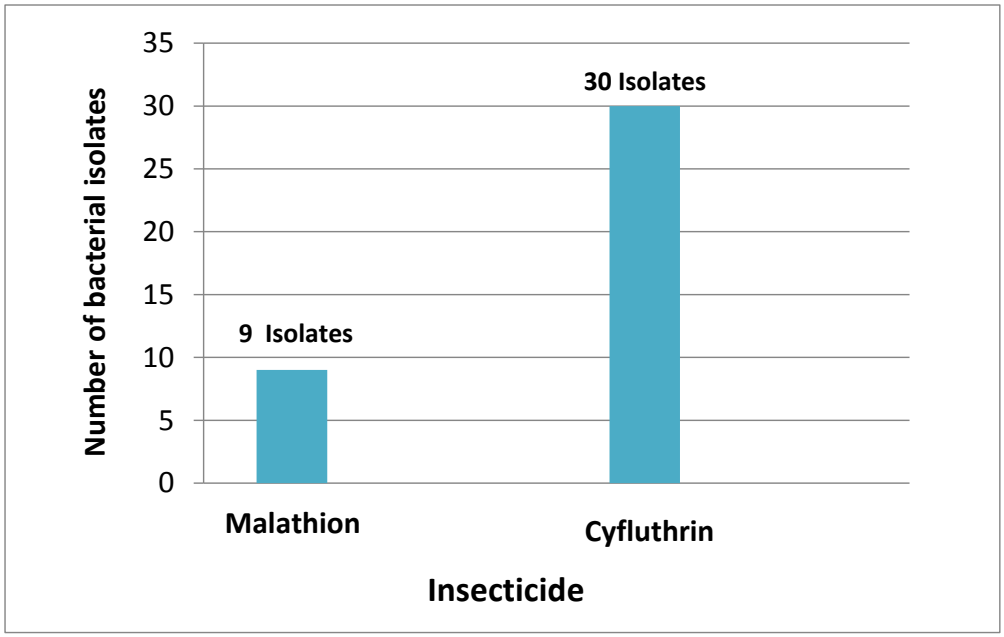

Fig. (3): Number of biodegradable bacterial isolates on a solid medium supplemented with 100 ppm of malathion or cyfluthrin

In addition, Khan *et al*. (2016) observed that the microbial isolates could grow in the medium (MSM) enriched with 35 µg/ml malathion as a source of carbon, phosphorus, or both, for two days at 32°C. The most efficient bacterial isolate was identified as *Bacillus licheniformis*. **Saengsanga and Phakratok (2023)** Obtained that three bacterial isolates of *Priestia megaterium* for NRRU-BW3 code, *Bacillus siamensis* for NRRU-BW9 code and *Bacillus amyloliquefacien*s for NRRU-TV11 code were able to grow in the MSM agar complementary medium 50 mg/L of the insecticide (chlorpyrifos) at 30°C for 24 h. **Asamba *et al*. (2022**) reported that the ability of four bacterial isolates *Lysinibacillus* sp. *Stenotrophomonas maltophilia*, *Pseudomonas putida*, and *Achromobacter insuavis* out of the eighteen isolates to grow in the nutrient agar medium supplemented with an insecticide (10 ppm chlorpyrifos 55%EC) for seven days at 30°C.

Table (1): Qualitative determination for screening biodegradable bacterial isolates on a solid medium supplemented with 100 ppm of malathion or cyfluthrin.

Insecticide	Isolates codes	Growth degree		
		Scant (+)	Moderate (++)	High (+++)
Malathion	S.MC.2			(+++)
	S.MC.3	(+)		
	S.MC.6		(++)	
	S.MC.10	(+)		
	S.MC.11			(+++)
	S.MC.12			(+++)
	S.MC.15			(+++)
	S.MC.16			(+++)
	S.M.2+M3	(+)		
Cyfluthrin	S.C.21	(+)		
	S.Z.9			(+++)
	S.Z.14			(+++)
	S.MC.1		(++)	
	S.MC.2			(+++)
	S.MC.3		(++)	
	S.MC.6			(+++)
	S.MC.10	(+)		
	S.MC.11	(+)		
	S.MC.12	(+)		
	S.MC.15			(+++)
	S.MC.16			(+++)
	S.MC.19		(++)	
	S.M.1+M3		(++)	
	S.M.2+M3		(++)	
	S.M3+M3			(+++)
	S.M.4+M3.1		(++)	
	S.M.4+M3.2		(++)	
	S.PO.6	(+)		
	S.PO.20	(+)		
	S.PO.21	(+)		
	S.PO.50	(+)		
	S.PO.64	(+)		
	S.PO.68	(+)		
	S.P.30		(++)	
	S.P.31	(+)		
	S.P.35			(+++)
	S.F.16	(+)		
	S.F.25	(+)		
	S.F.27	(+)		
The number of isolates		17	9	13
The distrubution percentage (%)		43.6	23.1	33.3

(+) = scant growth, (++) = Moderate growth, (+++) = High growth.

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• Quantitative determination in broth medium in the presence of the tested insecticides

The basic test for the breakdown of insecticides by microbial isolates that have the ability to grow in a liquid broth medium. After 7 days at the end of the incubation period, the (high tolerance) thirteen selected bacterial isolates were cultured in the presence of the insecticides (five isolates for malathion and eight isolates for cyfluthrin) at 100 ppm concentration. Results in Fig. (4 a) show that a high significant growth on malathion and control medium without malathion, which expressed as optical density (OD) was achieved by isolate code of S.MC.2 (OD of 1.02 and 2.37) followed by S.MC.12 (OD of 0.94 and 1.62) and S.MC.16 (OD of 0.62 and 1.54), respectively. While the lowest growth was 0.33 by both, isolate codes S.MC.11 and S.MC.15.

In the presence of cyfluthrin insecticide Fig. (4 b), the highly significant growth of 1.39 and 1.37 was recorded by isolate codes S.M3+M3 and S.Z.14, followed by isolate code S.MC.6 and S.MC.16 (OD of 1.24 and 1.17), respectively. While the lowest growth was**,** 0.73 and 0.86 achieved by isolate codes S.MC.15 and S.MC.2, respectively.

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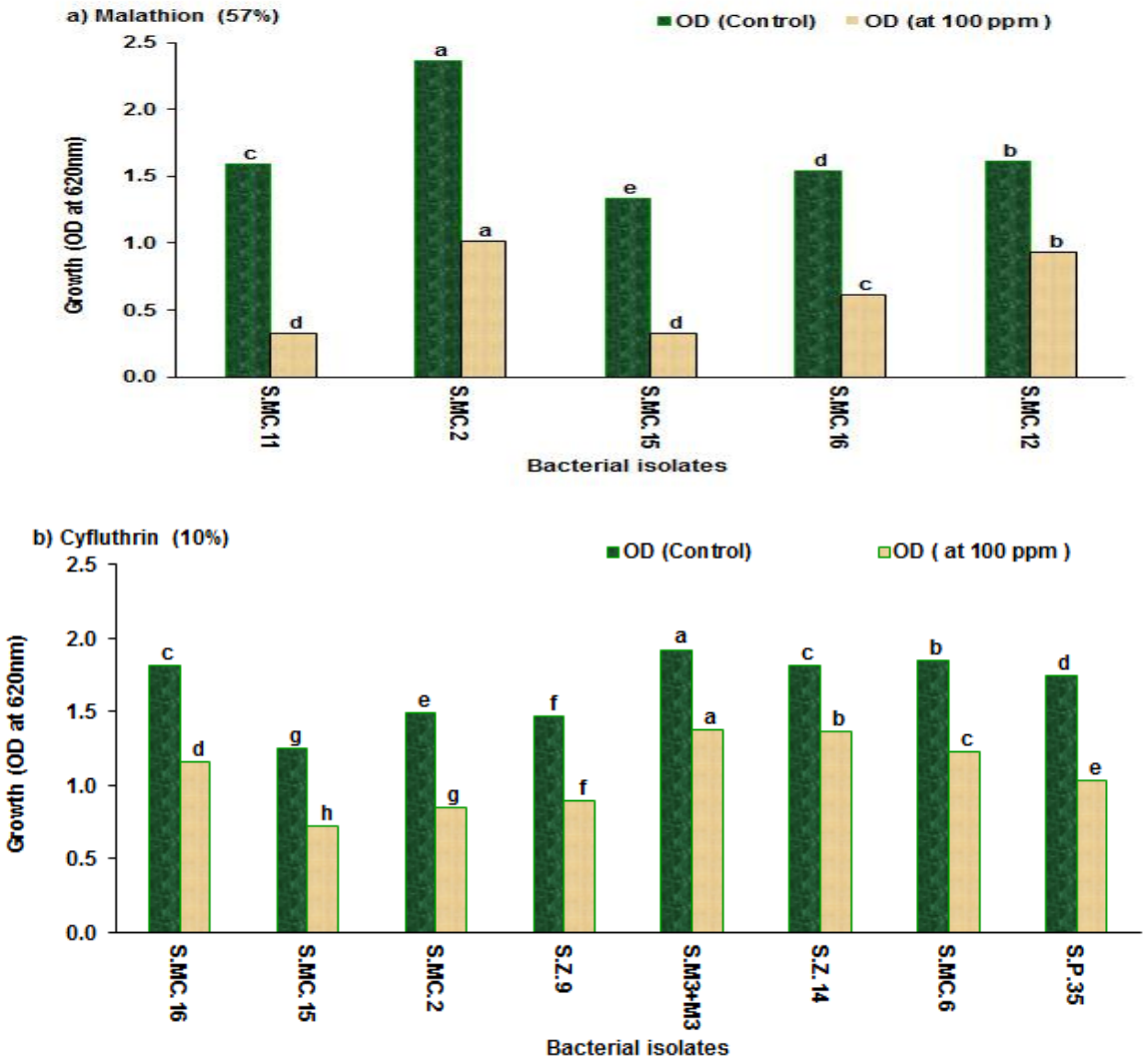

Fig. (4): Optical density of the selected bacterial isolates in broth medium containing (a) malathion or (b) cyfluthrin at 100 ppm of concentrations

•[a,b] values with small letters in the same column having different superscripts indicate a significant difference (at $p \leq 0.05$) and the same letter does not significantly differ from each other, according to Duncan's at 5% level.

From the above results, it could be stated that six bacterial isolates out of thirteen isolates were selected for further study as high insecticide biodegradable bacterial isolates,

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three isolates with codes S.MC.2, S.MC.12, and S.MC.16 biodegradable malathion as well as three isolates with codes S.M3+M3, S.Z.14, and S.MC.6 biodegradable cyfluthrin.

Khan *et al.* (2016) found that the *Bacillus licheniformis* strain ML-1 is highly efficient in degrading malathion and about 78% degradation of malathion was obtained within 5 days of incubation. In addition, they found that the growth of the bacterial was steady increase in MSM supplemented with malathion as a sole source of carbon within 5 days of incubation. **Shoman *et al*. (2022**) demonstrated that the most effective bacterial isolates for breaking down chlorpyrifos in liquid media converted the chemical into 3,5,6-trichloro-2-pyridinol (TCP) and chlorpyrifos oxon, which have a minor harmful impact on the ecosystem. These strains are also suggested for use in reducing the toxicity of chlorpyrifos in the environment, particularly in soil and plants. *Pseudomonas fluorescens* achieved the highest decomposition efficiency of 58.9%, then *Rhizobium leguminosarum* 56%, and finally *Bacillus megaterium* with 50.69%. **Saengsanga *et al.* (2023)** showed the degradation rates of 10 mg/L chlorpyrifos by *Priestia megaterium*, *Bacillus siamensis*, and *Bacillus amyloliquefaciens* were 33%, 47%, and 52%, respectively. Growing conditions, inoculum size, and bacterial species all affect how quickly bacteria can biodegrade chlorpyrifos. When additional nutrients are added to the standard metabolic processes, the breakdown of chlorpyrifos is significantly accelerated among high-growth, quickly metabolised compounds, which further accelerates degradation **(Anwar *et al.*, 2009).**

Effect of the tested insecticides on the growth of the selected bacterial isolates

The basic test for degradation of insecticides by microbial isolates that have the ability to grow in a liquid broth medium. After 15 days from the end of the incubation period, the selected bacterial isolates were cultured in the presence of 855, and 1425 ppm of malathion and 400, and 800 ppm of cyfluthrin. The data in Fig. (5) showed the ability of three tested isolates to grow at malathion concentrations (0, 855, and 1425 ppm). It was found that at 855 ppm, the cell dry weight of bacterial isolate codes S.MC.2, S.MC.16, and S.MC.12 was 1.16, 1.00, and 1.27 g/l, and at 1425 ppm, it was 1.02, 0.95, and 0.99 g/l, respectively. In comparison, growth at control (0 ppm of insecticide) was 1.31, 1.13, and 1.81 g/l for isolate

codes S.MC.2, S.MC.16, and S.MC.12, respectively. The pH values at 0, 855, and 1425 ppm malathion were 6.55, 6.05, and 5.73 for isolate S.MC.2, 6.77, 6.27, and 6.20 for isolate S.MC.16, and 6.84, 6.07, and 6.11 for isolate S.MC.12, respectively. The percentage of cell dry weight reduction after growing in the presence of malathion at 855 ppm was 11.45,11.50, and 29.83%, while at 1425 ppm it was 22.14, 15.93, and 45.30% for isolate codes S.MC.2, S.MC.16, and S.MC.12, respectively, as compared to control. According to these outcomes, a significant reduction in cell dry weight was observed for isolate S.MC.16 at 855 and 1425 ppm concentrations of malathion, indicating that this isolate could tolerate insecticide better than the other tested isolates.

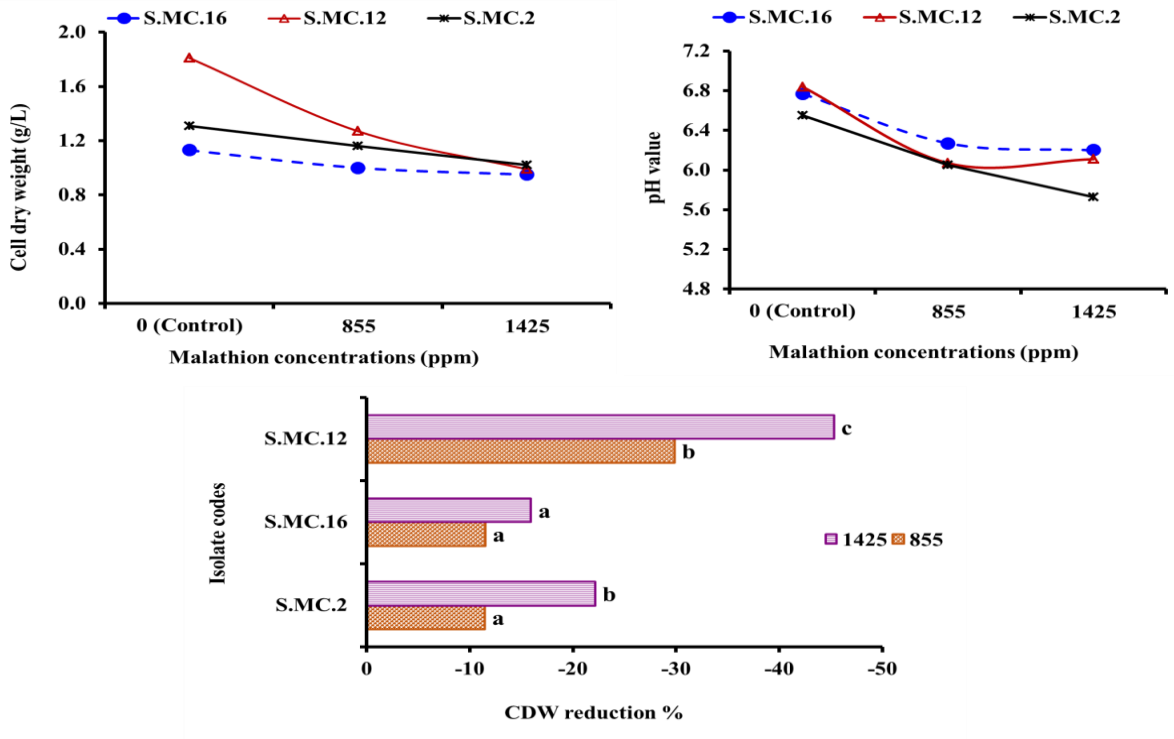

Fig. (5): pH, cell dry weight, and reduction percentage of selected bacterial isolates for malathion (57%w/v) degradation using a shake flask at 30ºC after 15 days at different concentrations in broth medium

•[a,b] values with small letters in the same column having different superscripts indicate a significant difference (at $p \leq 0.05$) and the same letter does not significantly differ from each other, according to Duncan's at 5% level.

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Fig. (6) illustrated that the cell dry weights of the tested isolates; S.MC.6, S.M3+M3, and S.Z.14 toward the high concentrations of cyfluthrin were 0.85, 1.26, and 0.66 g/l at 400 ppm and 0.78, 0.86, and 0.64 g/l at 800 ppm, respectively. For isolate codes S.MC.6, S.M3+M3, and S.Z.14, the growth was 1.86, 1.53, and 1.10 g/l at control, respectively. The pH levels at 0, 400, and 800 ppm of cyfluthrin were 6.71, 6.31, and 6.61 for isolate S.MC.6, 6.37, 6.15, and 6.59 for isolate S.M3+M3, and 6.7, 6.71, and 6.61 for isolate S.Z.14, respectively. Additionally, the results showed that for isolate codes S.MC.6, S.M3+M3, and S.Z.14, the reduction in cell dry weight after growth in the presence of cyfluthrin at 400 ppm was 54.30, 17.65, and 40.00%, while at 800 ppm it was 58.06, 43.79, and 41.82%, respectively, as compared to control. The results presented suggest that isolate S.M3+M3 was more tolerant of the insecticide cyfluthrin than the other tested isolates, as evidenced by the isolate's highly significant reduction in cell dry weight at 400 and 800 ppm.

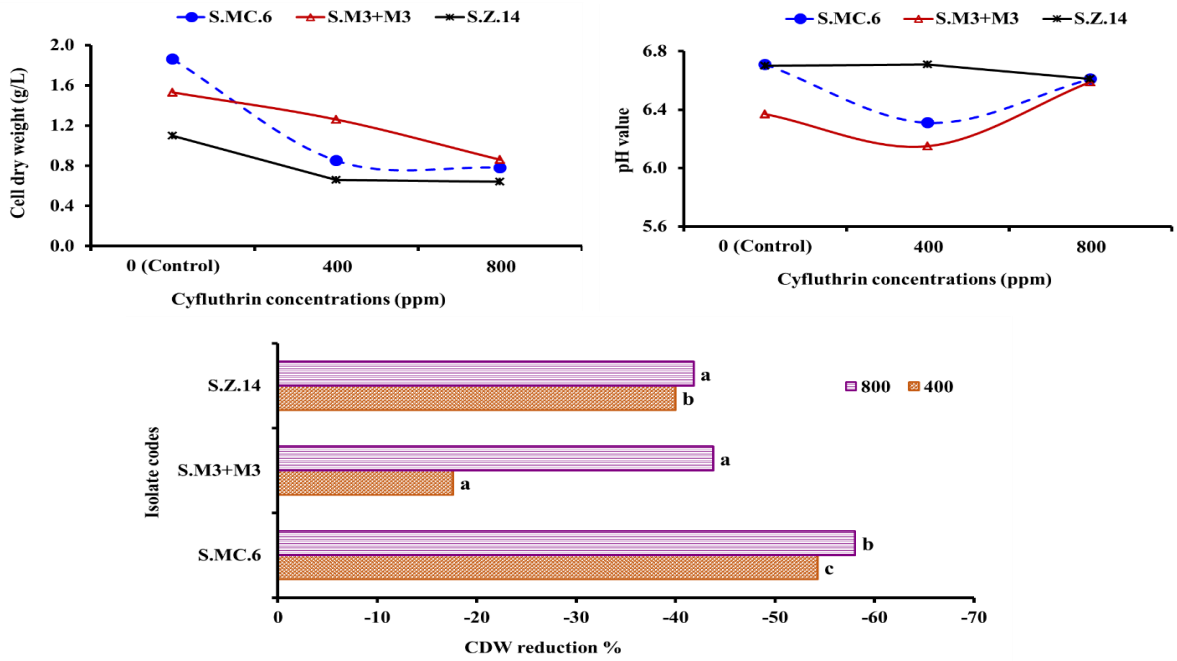

Fig. (6): pH, cell dry weight, and reduction percentage of selected bacterial isolates for cyfluthrin (10% w/v) degradation using a shake flask at 30ºC after 15 days at different concentrations in broth medium

•[a,b] values with small letters in the same column having different superscripts indicate a significant difference (at $p \leq 0.05$) and the same letter does not significantly differ from each other, according to Duncan's at 5% level.

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Aziz *et al. (* 2014) **& Jilani (2013)** revealed that the chosen bacterial isolates were grown in the presence of malathion insecticide at concentrations of 6841, 14253, 28506, and 42759 ppm. The decomposition rates were 62.9%, 75.6%, 70.6%, and 81.6%, for the microbe *Pseudomonas aeruginosa* and were 8.5%, 82.9%, 95.3%, and 42.6% for *Bacillus subtilis*, respectively. The rate of biodegradation has slowed down as malathion concentrations have increased. The results suggested that the increasing organic load might lower the concentration of dissolved oxygen, which may be the result of the harsh and stressful conditions the bacterial culture is exposed to. Alternatively, it could be the low availability of dissolved oxygen (**Jilani 2004; Kumari *et al.* 2012; Singh *et al.* 2013**). Moreover, **Pankaj *et al.* (2016)** found that at 125 ppm of the insecticides cypermethrin, the degradation was 83% for the strains *Pseudomonas* spp. and *Bacillus* spp. **Gangola *et al.* (2018)** revealed that the selected microbial isolates were cultured with the insecticide cypermethrin according to the concentration (450 ppm), and the degradation rate was 95% for *Bacillus subtilis* microbe, which used the insecticide cypermethrin as the only source of carbon to grow.

CONCLUSION

The study demonstrated the effectiveness (ability) of bacteria isolated from sandy soil cultivated by mango plants (Qalyubia Governorate) to the biodegradation of malathion and cyfluthrin under laboratory conditions. This might shed light on the isolation of bacterial strains capable of biodegradation of the insecticides in the soil to reduce adverse environmental by insecticides pollution.

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REFERENCES

Abd El-Ghany, T. M. and Masmali, I. A. (2016). Fungal biodegradation of organophosphorus insecticides and their impact on soil microbial population. J. Plant Pathol Microbiol. Vol.7(5): 1000349. DOI: 10.4172/2157-7471.1000349.

Anwar, S.; Liaquat, F.; Khan, Q. M.; Khalid, Z. M. and Iqbal, S. (2009). Biodegradation of chlorpyrifos and its hydrolysis product 3,5,6-trichloro-2-pyridinol by *Bacillus pumilus* strain C2A1. J. Hazard Mater**.** 168: 400–405.

Asamba, M. N.; Mugendi. E. N.; Oshule, P. S.; Essuman, S.; Chimbevo, L. M.; Atego, N. A. (2022). Molecular characterization of chlorpyrifos degrading bacteria isolated from contaminated dairy farm soils in Nakuru County, Kenya. J. Heliyon. Vol. 8(3): e09176., 2405-8440. https://doi.org/10.1016/ j.heliyon.2022.e09176.

Aziz, M.W.; Sabit, H. and Tawakkol, W. (2014). Biodegradation of (malathion) by *Pseudomonas* Spp and *Bacillus* Spp. Isolated (from polluted) Sites in Egypt. Merican-Eurasian. J. Agric. & Environ. Sci. Vol.14 (9): 855-862.DOI: 10.5829/idosi.aejaes.2014.14.09.867.

Damalas, C. A. (2009). Understanding benefits and risks of pesticide use. Sci. Res. Essays. Vol. 4(10): 945-949.

Difco Manual (1984). Dehydrated culture media and reagents for microbiology. Laboratories incorporated Detroit. Michigan, 48232 USS, p, 621.

El-Sawah, M. M. A.; Kassem M.M.; Selim A. E. I.; Eman H. Ashour and El-Kadi, Sh.M. (2008). Production of some biodegradable polymers by some bacterial isolates. J. Agric. Sci. Mansoura Univ. , Vol. 33(8): 6053 – 6064.

Gamón, M. E.; Sáez, E.; Gil, J. and Boluda, R. (2003). Direct and indirect exogenous contamination by pesticides of rice farming soils in a Mediterranean wetland. Arch. Environ. Contam. Toxicol. 44:141–151.

Gangola, S.; Sharma, A.; Bhatt, P.; Khati, P. and Chaudhary, P. (2018). Presence of esterase and laccase in *Bacillus subtilis* facilitates biodegradation and detoxification of cypermethrin. Sci. Rep. 8:12755. DOI:10.1038/s41598-018-31082-5.

Hathout, A. S.; Amer, M. M.; Mossa, A. H.; Hussain, O. A.; Yassen, A. A.; Elgohary, M. R. and Fouzy, A.S.M. (2022). Estimation of the most widespread pesticides in agricultural soils collected from some Egyptian governorates. Egypt. J. Chem. Vol. 65 (1): 35 – 44.

Jilani, S. and Khan, M. A. (2004). Isolation, characterization and growth response of pesticides degrading bacteria. J. Biol. Sci. Vol. 4(1):15-20.

Jilani, S. (2013). Comparative assessment of growth and biodegradation potential of soil isolate in the presence of pesticides. Saudi J. Biol. Sci. Vol. 20(3): 257-264.

Khan, S.; Zaffar, H.; Irshad, U.; Ahmed, R.; Khan, A.; Shah, M. M.; Bilal, M.; Iqbal, M. and Naqvi. T. (2016). Biodegradation of malathion by *Bacillus Licheniformis* strain ML-1. Arch. Biol. Sci. Vol. 68(00):7-7. DOI:10.2298/ABS141218007K.

Książek-Trela, P. and Szpyrka, E. (2022). The effect of natural and biological pesticides on the degradation of synthetic pesticides. Plant Prot. Sci. 58: 273–291.

Kumari, A. R. ; Jeevan, G. ; Ashok, M. ; Rao, C. K. and Vamsi, K. S. K. (2012). Malathion degradation by *Bacillus* spp. Isolated from soil. IOSR J. Pharm.Vol. 2(4):37- 42.

Mehta, A. ; Bhardwaj, K. K. ; Shaiza, M. and Gupta, R. (2021). Isolation, characterization and identification of pesticide degrading bacteria from contaminated soil for bioremediation. Biol. Futura. 72:317-323.

Pankaj, S. A.; Gangola, S. ; Khati, P. ; Kumar, G. and Srivastava, A. (2016) . Novel pathway of cypermethrin biodegradation in a *Bacillus* sp. Strain SG2 isolated from cypermethrin-contaminated agriculture field. 3 Biotech. 6:1–11.

Raffa, C. M. and Chiampo, F. (2021). Bioremediation of Agricultural Soils Polluted with Pesticides: A Review. J. Bioeng. , Vol. (7):92. https://doi.org/10.3390/ bioengineering8070092.

Saafan, A. E.; Azmy, A. F.; Amin, M. A.; Ahmed, S.H. and Essam, T.M. (2016). Isolation and characterization of two malathion degrading *Pseudomonas* sp. in Egypt. Afr. J. Biotechnol. Vol. 15(31):1661-1672. DOI: 10.5897/AJB2016.15273.

Saengsanga, T. and Phakratok, N. (2023). Biodegradation of chlorpyrifos by soil bacteria and their effects on growth of rice seedlings under pesticide contaminated soil . Plant Soil Environ. Vol. 69(5): 210–220. https://doi.org/10.17221/106/2023-PSE.

Satapute, P.; Kamble, M. V.; Adhikari, S. S. and Jogaiah, S. (2019). Influence of triazole pesticides on tillage soil microbial populations and metabolic changes. Sci. Total Environ.651: 2334-234. https://doi.org/10.1016/ j. scitotenv.2018.10.0 99.

Shalaby, Sh. E. M. and Abdou, G. Y. (2010). The influence of soil microorganisms and bioorganic fertilizers on dissipation of some pesticides in soil and potato tube. J. Plant Prot. Res. Vol. 50 (1): 86-92.

Sharma, M. and Shrivastav, A. (2023). Evaluation of malathion Degradation by Bacterial Isolates from Agricultural Soil. Int. J. Curr. Microbiol. Appl. Sci. Vol. 12(04): 142-148. https://doi.org/10.20546/ijcmas.2023.1204.016.

Shoman, R.; Aggag, S. and Yacout, M. (2022). Biodegradation of chlorpyrifos by Some Bacterial Strains and Screening Their Degraded Genes. J. of Agricutural Chemistry and Biotechnology. Vol. 13(1):1-7.

Singh, B.; Kaur, j. and Singh, K. (2013). Bioremediation of malathion in soil by mixed *Bacillus* culture. Adv. biosci. biotechnol. Vol. 4(5): 674-678.

Srinivasulu, M. and Ortiz, D. R. (2017). Effect of pesticides on bacterial and fungal populations in Ecuadorian tomato cultivated soils. Environ. Process. 4: 93-105 https://doi.org/10.1007 /s40710-017- 0212-4.

تقييم بعض البكتيريا المعزولة من التربة على التحلل الحيوي للمالاثيون والسيفلوثرين

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المستخلص

أدى الاستخدام المكثف للمبيدات الحشرية إلى آثار خطيرة على المكونات البيئية. تهدف هذه الدراسة إلى تقييم دور البكتيريا المعزولة من التربة في تحلل المبيدات الحشرية (الملاثيون والسيفلوثرين). في هذه الدراسة تم عزل مائتين وثلاثين عزلة من مصادر مختلفة من التربة المصرية المُلوّثة بالمبيدات الحشرية المختلفة وذلك على وسط آجار مغذي، نمت العزلات بوجود المبيدات الحشرية بتركيز 100 جزء في المليون من الملاثيون والسيفلوثرين. وجد تسعة وثلاثون عزلة بكتيرية تحملت المبيدات المختبرة وكان أكثرها تحمل ثلاثة عشر نمت بسرعة في وسط سائل في وجود مبيد حشري تم اختباره. نمت ست عزلات بسرعة كما تم قياسها بالكثافة الضوئية. تم اختيار ثلاث عزلات بالرموز التالية S.MC.2 وS.MC.12 و S.MC.16 لتحلل الملاثيون، وتم اختيار ثلاث عزلات بالرموز التالية S.M3+M3 و S.MC.6 وS.Z.14 لتحلل السيفلوثرين. أظهرت العزلات المختارة قدرتها على تحمل التركيزات العالية من الملاثيون (855 & 1425 جزء في المليون) وسيفلوثرين (400 & 800 جزء في المليون). وبالمقارنة مع العينة الضابطة، كانت العزلات الأكثر كفاءة هي S.MC.16 و S.M3+M3، والتي كان لديها أقل نسبة من انخفاض الوزن الجاف للخلايا بعد النمو في وجود الملاثيون (عند 855 & 1425 جزء في المليون) وسيفلوثرين (400 & 800 جزء في المليون) مقارنة بالعينة الضابطة على التوالي.

الكلمات المفتاحية: العزلات البكتيرية، البكتيريا، الملاثيون، السيفلوثرين، التحلل الحيوي.