

**Evaluation the efficacy of *Metarhizium anisopliae* and some plant extracts in controlling the housefly, *Musca domestica* in laboratory conditions**

Akram Ali Mohammed

Plant Protection Department- Faculty of Agriculture- University of Kufa- Republic of Iraq

**Abstract**

A study of individual and combination between the entomopathogenic fungus *Metarhizium anisopliae* (Ascomycota: Hypocreales) and aqueous extract of three plant species including Nerium (*Nerium oleander*), Elias (*Myrtus communis*) and Sweet acacia (*Vachellia farnesiana*) were evaluated against adult houseflies, *Musca domestica* (Diptera: Muscidae) in laboratory conditions. The fungal bioassay was carried out at different conidial concentrations ranging from  $1 \times 10^4$  to  $1 \times 10^9$  spores  $\text{ml}^{-1}$ . Four concentrations of aqueous extract of each plant (25, 50, 75 and 100%) were used. The highest concentration of *M. anisopliae* ( $1 \times 10^9$  spores  $\text{ml}^{-1}$ ) caused the highest adult houseflies mortality (100%), which was significantly different from the mortalities caused by the other fungal concentrations. Aqueous extract of Nerium was significantly more effective caused the highest adult mortality (83%) at high concentration (100%) compared with Elias and Sweet acacia (54 and 33% respectively). Therefore, three concentrations of aqueous extract of Nerium (50, 75 and 100%) were used along with  $1 \times 10^7$  spores  $\text{ml}^{-1}$  *M. anisopliae* as an integrated pest management program against *M. domestica*. The combination of *M. anisopliae* and Nerium at all three concentrations caused more houseflies

**2018 285 – 268 : (1) 10 Kufa Journal For Agricultural Sciences**

mortality than individual treatments of *M. anisopliae* and Nerium respectively, 7 days post-application. Thus, a combined application of an entomopathogenic fungus and aqueous extract of Nerium may benefit from both, and it has proven effective for the control of houseflies.

Keywords: *Metarhizium anisopliae*; Nerium; *Musca domestica*; Plant extract

Receiving Date : 11 - 9- 2017

Acceptance Date : 30 - 10 -2017

## **Introduction**

The housefly, *Musca domestica* L. (Diptera: Muscidae) is a major domestic, medical, and veterinary insect pest that causes spoils food, irritation and acts as a vector of many human and animal pathogens (10). Housefly management relies heavily on insecticide application. However, houseflies have been reported as having developed insecticide resistance to many of their pesticide(26, 2). In addition, excessive use of pesticides results in enhancing pest resurgence as well as environmental/health problems. For these reasons, there is growing interest to explore and adopt some alternative methods that reduce pesticide use. Thus, biological control of housefly could be very promising being eco-friendly as well as cost-effective (21).

Microbial insecticides based on entomopathogenic fungi have been successfully used to control a variety of agricultural

insect pests (9). In addition, many studies have been investigated the efficacy of entomopathogenic fungi against mosquito (24, 20) and housefly, which are an important pest and disease vectors in poultry production facilities (11, 21). These studies have investigated the potential use of fungal pathogens, especially isolates of *Beauveria bassiana*, *Lecanicillium* spp and *Metarhizium anisopliae* for control of *M. domestica*, which ranged from simple laboratory assays (12, 19, 7, 5, 23) through to semi-field and field evaluations (27,16, 25, 23). Mishra *et al.* (23) studied the susceptibility of the adult and larval stage of housefly, *M. domestica* to two entomopathogenic fungi, *M. anisopliae* and *B. bassiana* under laboratory and simulated field bioassays. Although they found that *B. bassiana* and *M. anisopliae* strains are highly effective in controlling the population of adults and larvae of housefly larvae and show a higher rate of mortality

within 4 days, *M. anisopliae* was found to be more effective in controlling both stages, with the optimum dose of  $10^9$  conidia  $\text{ml}^{-1}$ . However, the efficacy of entomopathogenic fungi is highly dependent on environmental conditions, where several studies have reported that a high level of relative humidity (100% RH) for at least 14 h after inoculation is required to obtain a good control level (13, 22). Thus, they can be applied in combination with other biocontrol agents as a part of integrated pest management programme to increase the mortality level of insect pests.

Control of insect pests can also be achieved by natural insecticides from plants. These are more environmentally and toxicologically safe and more selective and efficacious insecticides which act as insect repellents or insect anti-feed ants, alter insect growth and development ecdysis (molting), and behavior during mating and oviposition. Kazim (18) studied the

efficacy of aqueous extracts of the Sidr *Ziziphus spp* and Nerium oleander *Nerium spp* and Elias *Myrthus commuis* and olive *Olea sp* against the larvae of *M. domestica*. He found that Nerium was most effective in controlling *M. domestica* with a 90 % mortality compared with other plant extracts.

There is no information on the interaction between entomopathogenic fungus *M. anisopliae* and aqueous plant extracts including Nerium, Elias and Sweet acacia (*Vachellia farnesiana*) for management of housefly. Accordingly, the study was planned to determine the efficacy of these biocontrol agents alone and in combination in controlling *M. domestica* in laboratory conditions.

## **Materials and methods**

### *Rearing of M. domestica*

Adult houseflies were collected by sweep net from poultry and sheep fields at Faculty of Agriculture, University of Kufa,

Najaf, Iraq, and reared in 45×45 × 45 cm cages covered with a muslin cloth. Adult flies were held at room temperature  $28\pm 5^{\circ}\text{C}$  in Entomology Laboratory and were fed on a mixture of 4 g groundnut oil cake, 10 g wheat bran, 4 g milk powder, 2 g honey and all mixed with 10 ml of water. Eggs being laid were transferred to another cage containing groundnut oil cake and wheat bran in 1:3 ratios. Hatched larvae were transferred individually to rearing cages and fed on diet mixture described above, this food was changed daily until pupal stage. Pupae were transferred to petri plates, containing no food or moisture. Emerged adult flies were housed in rearing cages at room temperature and were fed on diet mixture described above. About 1–2 days old flies were used for the bioassays.

#### Plant samples

Leaves of three different plant species which included Nerium (*Nerium oleander*), Elias (*Myrtus communis*) and Sweet

acacia (*Vachellia farnesiana*) were collected from gardens of Faculty of Agriculture, University of Kufa. Leaves were placed into tared, brown paper bags and then samples were dried in a forced-draft oven at  $50^{\circ}\text{C}$  for 2 days. Then, dried leaves were grinded by an electrical grinder to obtain a very fine powder that placed into paper bags and kept in the fridge until use.

#### Aqueous extract of plants

Aqueous plant extract for leaves of each plant species was obtained by using the method described by Kayode (17). A 100 g of each fine powder were placed individually in a 1000 ml beakers contained 200 ml hot water and mixed together using the electrical mixture for 10 min. The mixture was left for 24 h and filtered using filter papers, and then some sterilised water was added until 200 ml to produce the stock solution. Four concentrations of each aqueous extract were prepared (100, 75, 50 and 25%)

and kept in the fridge at 4°C until use.

Efficacy of different concentrations of aqueous plant extract in controlling adults *M. domestica*

Five treatments were carried out for each aqueous plant extract to investigate the efficacy of four concentrations of each aqueous extract (100, 75, 50 and 25%) against adult houseflies. Four (45×45 × 45 cm) cages covered with a muslin cloth (containing a total of 25 adults per cage) for each treatment were used. In each treatment, 5 ml of each concentration were added to the diet mixture as described above. In control cages, the diet was mixed with sterilised water only. Dead flies were counted after 1, 2 and 3 days.

Entomopathogenic fungus

A formulation of *M. anisopliae* (Met52<sup>®</sup> by Novozymes Biologicals Inc., Salem, Virginia, USA) was used. The product is based on conidia of the F52 strain isolated from the dead larvae of a Codling moth in Austria(8). This

mycoinsecticide contains  $5 \times 10^{10}$  spores  $g^{-1}$  and was kept at 4°C until use. For preparation suspensions, a stock suspension was prepared by mixing 100 g of Met52<sup>®</sup> powder in 1000 ml of sterile water and 0.02% Tween 80 (BDH Chemicals Ltd., Poole, UK) in 2000 ml beakers then agitating for 30 minutes with a magnetic stirrer. The resulting concentration was diluted to produce lower fungal concentrations that sprayed in the treatments. The viability of spores was determined by spraying 0.1 ml of  $1 \times 10^8$  spores  $ml^{-1}$  on a sterile Petri dish with 1.5% Sabouraud dextrose agar (SDA). The dishes were sealed with parafilm and incubated at 22°C,  $90 \pm 2\%$  RH and a photoperiod of 16:8 (L:D) h. After 24h, the number of germinated spores per 100 spores of each plate was assessed under the microscope (400× magnification). Germination was considered positive when the length of the germ tube was at least half the spore length. The viability

of the *M. anisopliae* spores used in the bioassays exceeded 97%.

Efficacy of *M. anisopliae* against adult houseflies

For each treatment, 25 adult houseflies (1–2 days old) of each replicate were anesthetized by cold treatment at 4°C for 3 min and then placed on a filter paper (Whatmann No.1) in petri plate (150×25 mm, BOROSIL®) containing the adult housefly food. Fungal suspension (1 ml) with  $1 \times 10^4$ ,  $1 \times 10^5$ ,  $1 \times 10^6$ ,  $1 \times 10^7$ ,  $1 \times 10^8$  or  $1 \times 10^9$  spores ml<sup>-1</sup> of *M. Anisopliae* were sprinkled on diet. Petri plates were incubated at 25±5°C and 75% RH. Five replicates per treatment were carried out. Plates in the control treatment were sprayed with 1 ml of sterile distilled water containing 0.1% Tween 80. Dead flies were counted and removed daily for 9 days. Dead flies were surface sterilized by immersion in a solution of 10% sodium hypochlorite and Tween 80 for 10 min, rinsed once in 70% ethanol and three times with sterile distilled water and then placed on

agar (65 g of SDA in 1,000 ml water and mixed with 10 g of yeast extract, autoclaved at 121°C and 15 lb for 15 min) in Petri plates and incubated at 25±5°C, 75% RH, for growth of fungus on cadaver, to confirm fly infection with fungus (23).

Interaction between *M. anisopliae* and aqueous plant extract for controlling *M. domestica*

The objective of this experiment was to determine the effect of interaction between different concentrations of aqueous plant extracts and *M. anisopliae* in increasing the mortality level of *M. domestica*. Concentrations of *M. anisopliae* and aqueous plant extract of Nerium were selected from the individual trials based on the levels of mortality induced by *M. anisopliae* and Nerium. It used four concentrations of Nerium (100, 75, 50 or 25%), *M. anisopliae* at concentration  $1 \times 10^7$  spores ml<sup>-1</sup>, and a combination of these two treatments to investigate adult mortality of *M. domestica*. Seven treatments were carried out.

For interaction treatments, 50 adult houseflies (1–2 days old) of each replicate were anesthetized by cold treatment at 4°C for 3 min and then placed on a filter paper containing the adult housefly diet as described above. 1 ml of *M. anisopliae* at concentration  $1 \times 10^7$  spores ml<sup>-1</sup> of *M. anisopliae* was sprinkled on diet. Petri plates were incubated at 25±5°C and 75% RH for 4 h. Afterwards, adult flies were transferred to rearing cages at room temperature and were fed on diet mixture with 5 ml of each concentration (100%, 75%, 50% or 25%) of *N. oleander*. Five replicates per treatment were carried out. In addition, one treatment was exposed to *M. anisopliae* for 4 h and then transferred to rearing cages containing diet only as a fungal treatment, and one treatment was sprayed with sterile distilled water and then transferred to rearing cages containing diet mixture with 5 ml of each concentration of plant extract. Houseflies in the control treatment were sprayed with 1 ml

of sterile distilled water and then transferred to rearing cages containing diet only. Dead flies were counted and removed daily at 1, 3, 5 and 7 days after treatment.

#### Statistical analysis

Statistical analyses were conducted using GenStat (version 16; VSN International, Hemel Hempstead, UK). Normality of data distribution was estimated using a Shapiro-Wilk test (W-test). The data were transformed using logit transformation when it was necessary to meet the assumption of normality. Mortality was corrected for natural death in the control using Abbott's formula (1), which calculates the proportion of houseflies killed by the fungus alone. A two-factor repeated measurement analysis ANOVA was used to test the effect of fungal concentration and time after application on the housefly mortality. The effect of plant extracts and concentration of plant extract were assessed using two-factor ANOVA. two-factor repeated measurement ANOVA

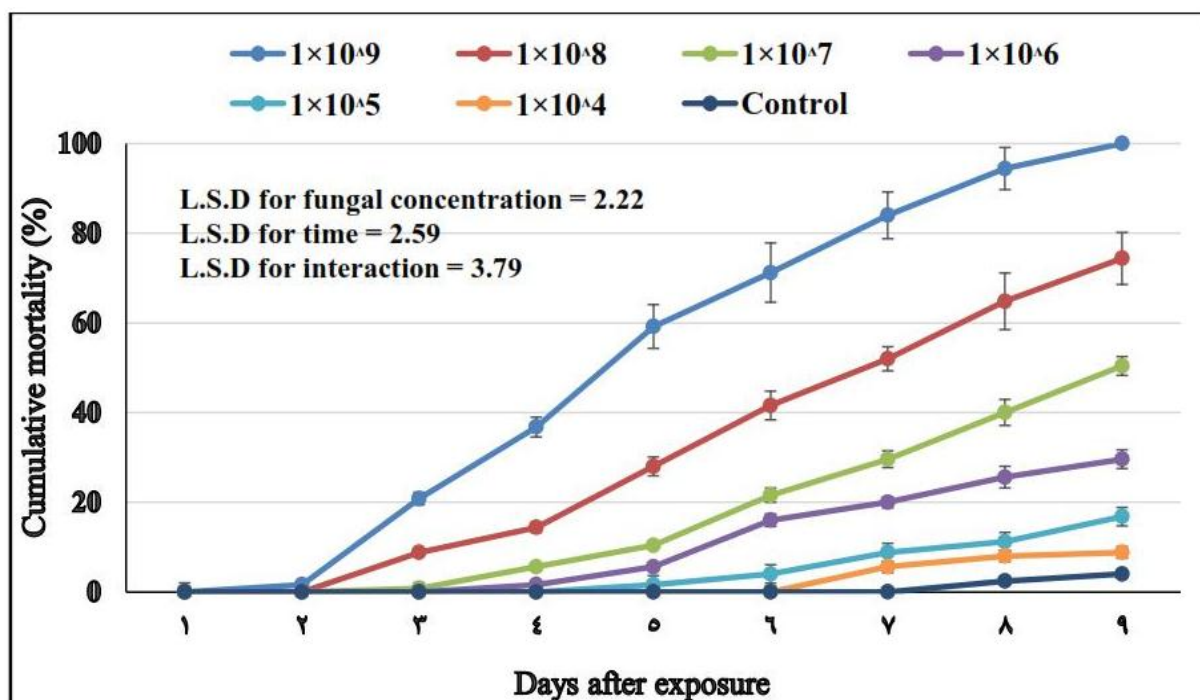
was used to determine the individual effects of *M. anisopliae* and different concentrations of plant extract (Nerium) in addition to their combined effects. Mean comparisons were performed using LSD test at 5% level of significance ( $P < .05$ ).

#### Results and Discussion

##### Efficacy of *M. anisopliae* against *M. domestica*

Mortality of adult housefly was increased significantly according to the concentration of *M. anisopliae* ( $P \leq 0.001$ ) and days after fungal application ( $P \leq 0.001$ ). Significant results were also obtained for interaction between concentration and time ( $P \leq 0.001$ ). Absolute mortality was recorded at 4 days in all the treatments except lower fungal concentration ( $1 \times 10^4$  spores  $\text{ml}^{-1}$ ) and control where 5.6% and 2.4 % mortalities were recorded at days 7 and 8, respectively. At day 9 post-exposure, 74.4–100% mortality of adult housefly was achieved with high conidial concentrations

( $1 \times 10^8$  and  $1 \times 10^9$  spores  $\text{ml}^{-1}$ ) (Figure 1). This study showed that conidial concentration of *M. anisopliae* plays an important role in increasing the mortality of houseflies as a result of increasing the number of effective fungal conidia. In addition, the present study gave absolute mortality of houseflies in 4 days after exposure. This is due to the process of germination, penetration and sporulation of entomopathogenic fungus, which required at least 96h at optimal conditions and could be more than 96 h at below or above optimal conditions (3). This was expected before starting the laboratory bioassays because all entomopathogenic fungi have a slow killing process leading to mortality that increases with the time. The result was in agreement with the data obtained by Barson *et al.* (6) and Mishra *et al.* (23) who reported high mortality of adult houseflies within 6 days of exposure of *M. anisopliae* at  $1 \times 10^9$  spores  $\text{ml}^{-1}$ .



**Figure 1:** The effect of different concentrations of *M. anisopliae* and the time after application on the corrected mortality (mean ± SE) of adult housefly sprayed with *M. anisopliae* compared to the control treatment.

Efficacy of aqueous extract of plants against *M. domestica*

Results indicated that aqueous extract of plants had a significant effect on the corrected mortality of adult housefly caused by aqueous extract of different plants 5 days after exposure ( $P \leq 0.001$ ), with the highest mortality found in housefly fed on diet treated with Nerium, compared to lowest mortality found in those fed

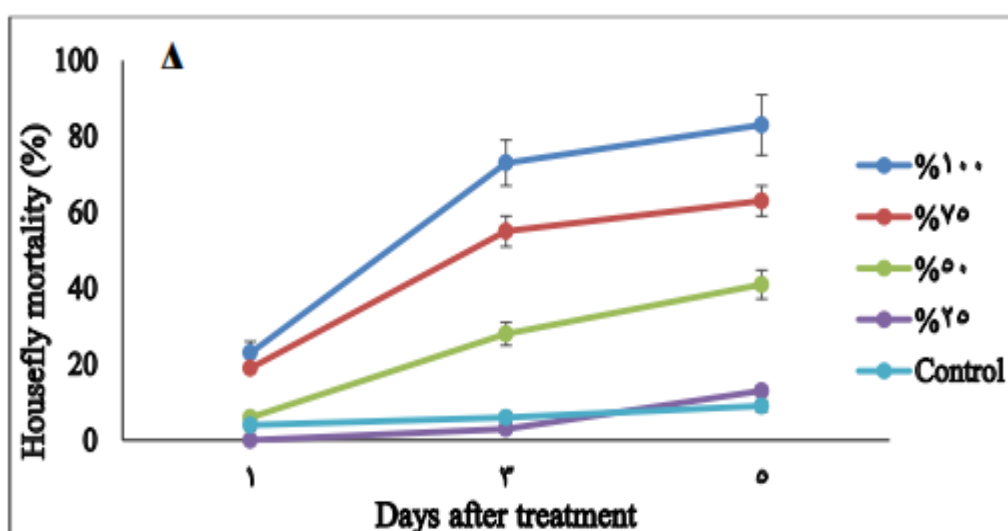
on diet mixed with sweet acacia (Figure 2). The effect of concentration of aqueous extract and time after exposure on the percentage of housefly corrected mortality was significant ( $P \leq 0.001$ ), with 83% mortality recorded for adult housefly exposed to aqueous extract of Nerium at concentration (100%) 5

days post exposure, compared to 23% at day 1 after exposure (Figure 2). Housefly mortality in control treatments ranged between 6% and 9%. The differences in efficacy of an aqueous extract of plants used in the current study may be related to their differences in the chemical compounds which are significantly affecting the mortality rate of treated insect pests. Several previous studies supported these findings, Kazim (18) reported that the efficacy of aqueous extracts of Nerium was significantly high than those of the Sidr and Elias against larval stage of houseflies. Akbar *et al.* (4) reported that the mortality rate of larvae of housefly exposed to

aqueous extracts of *Quercus brantti* was significantly higher than those larvae exposed to aqueous extracts of *Eucalyptus camaldelulensis*, *Plantago lanceolata* and *Rumex dentatus*.

Combined effects of *M. anisopliae* and Nerium against *M. domestica*

Mean number of dead houseflies was significantly different among the treatments ( $P \leq 0.001$ ) and period of time after application ( $P \leq 0.01$ ). The combined effect of *M. anisopliae* and Nerium at all three different concentrations (100, 75 and 50%) produced a more rapid mortality response in adult housefly as indicated by the mean number of



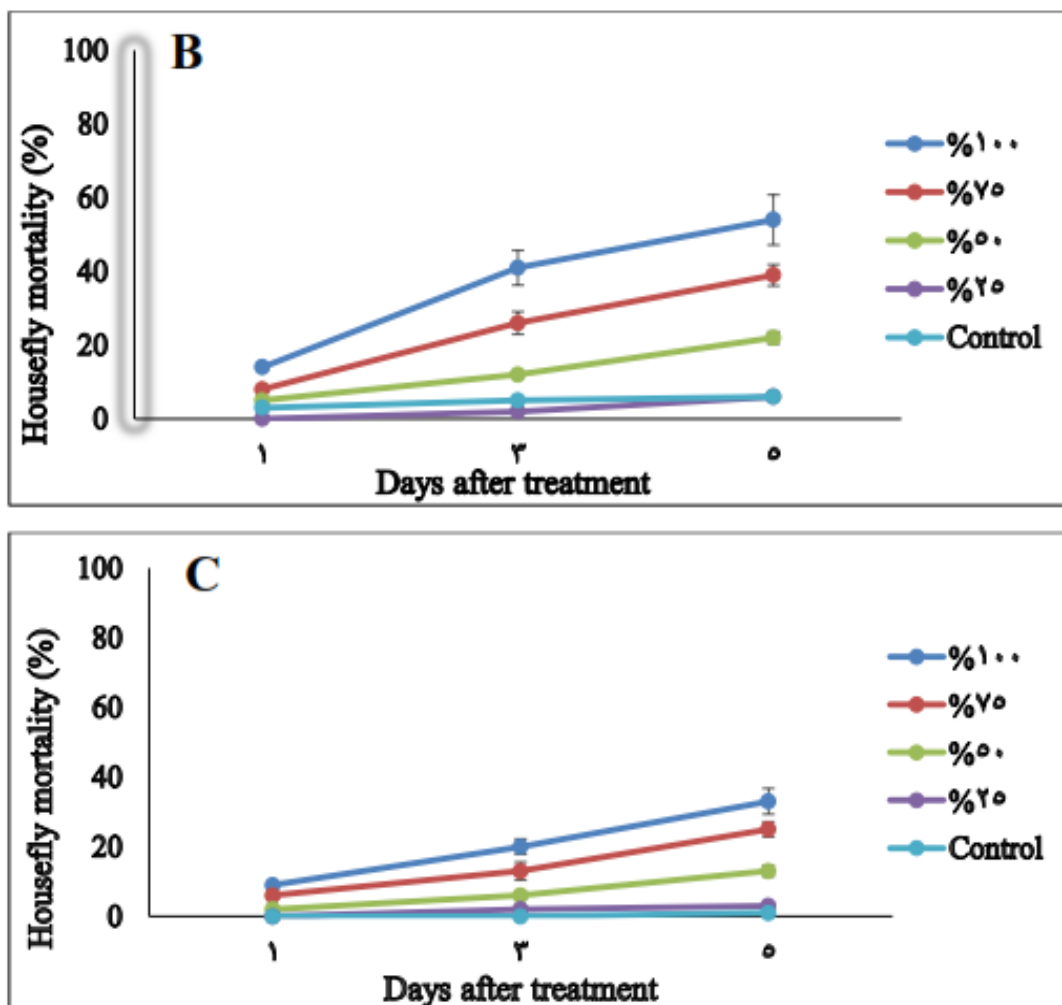


Figure 2: Mean ( $\pm$ SE) adult mortality of adult houseflies exposed to various concentrations of aqueous extract of (A) Nerium; (B) Elais; (C) Sweet acacia, after 1, 3 or 5 days of exposure compared with control treatment. LSD for plant species = 1.73; LSD for concentration of aqueous extract = 2.08; LSD for interaction = 2.54.

**Table 1:** Mean number of dead houseflies exposed to single or integrated treatments of *M. anisopliae* ( $1 \times 10^4$  spores ml<sup>-1</sup>) and Nerium at all three different concentrations (100, 75 and 50%) compared with control treatment.

Treatments	Housefly No.	Dead No. after 24 h	Dead No. after 72 h	Dead No. after 120 h	Dead No. after 168 h	Cumulative Dead No.
<i>M. anisopliae</i> + 100 % aqueous extract of Nerium	50	10	18.4	18.6	3	50
<i>M. anisopliae</i> + 75 % aqueous extract of Nerium	50	7.2	13.8	20.6	6.6	47.6
<i>M. anisopliae</i> + 50 % aqueous extract of Nerium	50	3.2	8.8	17.8	8.8	39
<i>M. anisopliae</i> at concentration $1 \times 10^7$ spores ml <sup>-1</sup> only	50	0	0.4	4.8	10	15.2
100 % aqueous extract of Nerium only	50	11	14	5	6	36
Control	50	0	1	1	2	4
LSD for treatment = 2.76; LSD for time = 3.11 ; LSD for interaction = 3.72						

dead individuals compared with individual effects of *M. anisopliae* and Nerium against

adults' housefly. For example, the mean number adults housefly dead produced by combining *M.*

*anisopliae* and Nerium at either 100, 75 or 50% were 50, 47.6 and 39, respectively after 7 days of exposure, compared to 36 and 15.2 for those houseflies exposed to *M. anisopliae* or Nerium only (Table 1). A similar phenomenon was reported by Islam et al. (14) who found that the combination of *B. bassiana* with neem resulted in 27.6 and 20.5% more nymphal mortality of the whitefly *Bemisia tabaci* 7 days post-application than individual treatments of *B. bassiana* and neem, respectively. In addition, James (15), found that up to 90% nymphal mortality of the whitefly *B. argentifolii* was obtained when *Paecilomyces fumosoroseus* were combined.

## References

- 1- Abbott W.S. 1925. A method for computing the effectiveness of an insecticide. *Journal of Economic Entomology*, 18:265–267
- 2- Acevedo G.R.; M. Zapater and Toloza A.C. 2009. Insecticide resistance of house fly, *Musca domestica* (L.) from Argentina. *Parasitology Research*, 105:489–493.
- 3- Acharya N.; R.A.Seliga; E.G.Rajotte; N.E. Jenkins and Thomas M.B. 2015. Persistence and efficacy of a biopesticide against the house fly, on typical structural substrates of poultry houses. *Biocontrol Science and Technology*, 25:1–41.
- 4- Akbar M. M.; N.A. AL-Mansour and Kadhum A. 2011. The effect of some aqueous plant extract and their powders on the biological activity of house fly *Musca domestica* L. (Diptera: Muscidae). *Journal of Basra Researches*, 37: 6-17.
- 5- Anderson R. D.; A. S. Bell; S. Blanford; K. P. Paaijmans and Thomas M. B. 2011. Comparative growth kinetics and virulence of four different isolates of entomopathogenic fungi in house fly (*Musca domestica* L.). *Journal of Invertebrate Pathology*, 107: 179–184.
- 6- Barson G.; N. Renn and Bywater A.F. 1994. Laboratory

- evaluation of six species of entomopathogenic fungi for the control of house fly (*Musca domestica* L.), a pest of intensive animal units. *Journal of Invertebrate Pathology*, 64:107–113.
- 7-** Cova L. J.; J.V. Scorza-Dagert; D.E. Garcia; L. M. Canizales; C.D. Guedez; M. L. Avendano and Medina M. G. 2009. Effect of *Beauveria bassiana* and *Beauveria brongniartii* for the house fly (*Musca domestica*) control on laboratory and poultry sheds conditions. *Boletin De Malariologia Y Salud Ambiental*, 49, 151–160.
- 8-** Fargues J.; C. Vidal; N. Smits; M. Rougier; T. Boulard; M. Mermier and Ridray G. 2003. Climatic factors on entomopathogenic hyphomycetes infection of *Trialeurodes vaporariorum* (Homoptera: Aleyrodidae) in Mediterranean glasshouse tomato. *Biological Control*, 28: 320-331.
- 9-** Faria M. R.; and Wraight S. P. 2007. Mycoinsecticides and mycoacaricides: a comprehensive list with worldwide coverage and international classification of formulation types. *Biological Control*, 43: 237-256.
- 10-** Forester M.; S. Klimpel and Sievert K. 2009. The house fly (*Musca domestica*) as a potential vector of metazoan parasites caught in a pig-pen in Germany. *Veterinary Parasitology*, 160:163–167.
- 11-** Geden C. J. 2012. Status of biopesticides for control of house flies. *Journal of Biopesticides*, 5: 1–11.
- 12-** Geden C.J.; D.A. Rutz and Steinkraus D.C. 1995. Virulence of different isolates and formulation of *Beauveria bassiana* for house flies and the parasitoid *Muscidifurax raptor*. *Biological Control*, 5:615–621.
- 13-** Hall R. A. 1981. The fungus *Verticillium lecanii* as a microbial insecticide against aphids and scales. In Burges, H. D (ed), *Microbial control of pests*

- and plant diseases, 1970-1980 (pp. 438-498). Academic Press, London, UK.
- 14-** Islam M.T.; S.J. Castle and Ren S.X. 2010. Compatibility of the insect pathogenic fungus *Beauveria bassiana* with neem against sweetpotato whitefly, *Bemisia tabaci*, on eggplant. *Entomologia Experimentalis et Applicata*, 134: 28-34.
- 15-** James R.R. 2003. Combining azadirachtin and *Paecilomyces fumosoroseus* (Deuteromycotina: Hyphomycetes) to control *Bemisia argentifolii* (Homoptera: Aleyrodidae). *Journal of Economic Entomology*, 96: 25–30.
- 16-** Kaufman P. E.; C. Reasor; D.A. Rutz; J.K. Ketzis and Arends J. J. 2005. Evaluation of *Beauveria bassiana* applications against adult house fly, *Musca domestica*, in commercial caged-layer poultry facilities in New York state. *Biological Control*, 33: 360–367.
- 17-** Kayode J.2006. Pesticidal Activity of the Leaf and Extracts of *Gilircidia sepium* *Callosobruchus maculatus*. *Journal of Sustainable Forestry*, 22: 57-61.
- 18-** Kazim S. M. 2013. Effect of some plant extracts on the larvae of aquatic insects fly home (*Musca domestica*) (Diptera: Muscidae). *Magazin of Al-Kufa University for Biology*, 5: 15-20.
- 19-** Lecuona R.E.; M. Turica; F. Tarocco and Crespo D.C. 2005. Microbialcontrol of *Musca domestica*(Diptera: Muscidae) with selected strains of *Beauveria bassiana*. *Journal of Medical Entomology*, 42:332–336
- 20-** Leles R.N.; N.A. Sousa; L.F.N. Rocha; A.H. Santos; H.H.G. Silva and Luz C. 2010. Pathogenicity of some hypocrealean fungi to adult *Aedes aegypti* (Diptera: Culicidae). *Parasitology Research*, 107:1271–1274.
- 21-** Malik A.; N. Singh and Satya S. 2007. House fly (*Musca domestica*): areview of control

- strategies for a challenging pest. *Journal of Environmental Science and Health*, 42:453–469.
- 22-** Milner R. J.; and Lutton G. G. 1986. Dependence of *Verticillium lecanii* (Fungi: Hyphomycetes) on high humidities for infection and sporulation using *Myzus persicae* (Homoptera: Aphididae) as host. *Environmental Entomology*, 15: 380-382.
- 23-** Mishra S.; P. Kumar; A. Malik and Satya S. 2011. Adulticidal and larvicidal activity of *Beauveria bassiana* and *Metarhizium anisopliae* against house fly, *Musca domestica* (Diptera:Muscidae), in laboratory and simulated field assays. *Parasitology Research*, 108: 1483–1492.
- 24-** Mnyone L.L.; M.J. Kirby; M.W. Mpingwa; D.W. Lwetoijera; B.G.J. Knols; W. Takken; C.J.M. Koenraadt and Russell T.L. 2010. Infection of *Anopheles gambiae* mosquitoes with entomopathogenic fungi: effect of host age and blood-feeding status. *Parasitology Research*, 108: 317–322.
- 25-** Mwamburi L. A.; M.D. Laing and Miller R. M. 2010. Laboratory screening of insecticidal activities of *Beauveria bassiana* and *Paecilomyces lilacinus* against larval and adult house fly (*Musca domestica* L.). *African Entomology*, 18: 38–46.
- 26-** Srinivasan R.; P. Jambulingam; K. Gunasekaran and Boopathidoss P.S. 2008. Tolerance of house fly, *Musca domestica* (Diptera:Muscidae) to dichlorovos (76% EC) an insecticide used for fly control in the tsunami-hit coastal villages of southern India. *ActaTropic*, 105:187–190.
- 27-** Watson D. W.; D.A. Rutz and Long S. J. 1996. *Beauveria bassiana* and sawdust bedding for the management of the house fly, *Musca domestica* (Diptera: Muscidae) in calf hutches. *Biological Control*, 7: 221–227.

تقويم فعالية الفطر *Metarhizium anisopliae* وبعض المستخلصات النباتية في السيطرة  
على بالغات الذباب المنزلي *Musca domestica* في ظروف المختبر

أكرم علي محمد

قسم وقاية النبات - كلية الزراعة - جامعة الكوفة - جمهورية العراق

**المستخلص:**

تم إجراء هذه الدراسة لتقييم فعالية الفطر الممرض للحشرات *Metarhizium anisopliae* والمستخلص المائي لأوراق نبات الدفلة (*Nerium oleander*)، اليأس (*Myrtus communis*) و شوك الشام (*Vachellia farnesiana*) ضد بالغات الذباب المنزلي في ظروف المختبر. تم اختبار تراكيز بوغية مختلفة من الفطر *M. anisopliae* تراوحت بين  $1 \times 10^4$  الى  $1 \times 10^9$  سبور/مل<sup>-1</sup>. كما تضمنت الدراسة استخدام أربعة تراكيز من المستخلص المائي لكل نبات (25 ، 50 ، 75 و 100 %). بينت النتائج إن النسبة المئوية لهلاك بالغات الذباب المنزلي المعاملة بالمعلق البوغي للفطر *M. anisopliae* بتركيز وصلت إلى 100% بعد مرور 9 أيام وقد اختلفت معنويًا عن نسب الهلاك الناتجة عن التراكيز البوغية الأخرى. كما أظهرت الدراسة إن المستخلص المائي لأوراق نبات الدفلة كان أكثر فعالية حيث سجل أعلى معدل هلاكات لبالغات الذباب المنزلي (83%) عند التركيز 100% بعد مرور 5 أيام مقارنة مع المستخلص المائي لأوراق نبات اليأس و شوك الشام والتي سجلت نسب هلاك بلغت 54 و 33 % على التوالي. لذلك تم استخدام ثلاث تراكيز من المستخلص المائي لأوراق نبات الدفلة (50 ، 75 و 100 %) مع العالق البوغي للفطر *M. anisopliae* كبرنامج إدارة متكاملة لسيطرة على *M. domestica*. حيث بينت النتائج إن استخدام المستخلص المائي لأوراق الدفلة مع العلق البوغي للفطر قد أعطت نسب هلاك أعلى من رش كل واحد منها بشكل منفرد بعد مرور 7 أيام من المعاملة. يستنتج من النتائج مما سبق إن رش المستخلص المائي لأوراق نبات الدفلة مع العالق البوغي للفطر قد أعطت أعلى نسب هلاك لبالغات الذباب المنزلي ولم تؤثر عناصر المقاومة الحيوية المختبرة في الدراسة سلبيًا أحدهما على الأخرى.

الكلمات الافتتاحية: الفطر *Metarhizium anisopliae* ، الذباب المنزلي ، الدفلة ، المستخلصات النباتية

تاريخ الاستلام: 11-9-2017

تاريخ القبول: 30-10-2017