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The Influence of Environmental Factors on Biological Parameters of *Musca Domestica* (Diptera: Muscidae)

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Abstract: Influence of different temperatures (20-35°C) , moisture (relative humidities, 12, 52, 75 and 98%) and larval densities (100, 400, 600, and 1000) on the development time and mortality of the *Musca domestica* as well as impact of the survival rate, longevity, fecundity and fertility of adult *M. domestica* at temperatures (20-35°C) was studied. Present results indicated that the temperature was a great influence on mortality and development time of all immature and adult stages and the temperatures from 20 to 25°C have all the earmarks of being most appropriate for the egg, larva and pupa development.There was no significant overall mortality at 25°C under moisture levels of 52%, 75% and the development time of all immature and adult stages at a relative humidity (12% or 98%) significant increased and also, the mortality from egg to adult were significant increasing with increasing immature density. Larval density has a huge impact on the time required for the development of all immature stages and adult. The temperature was a great influence on the survival rate, longevity, number of eggs/female (fecundity) and fertility of the adult. So it can be concluded from this study that different temperature from 20 to 35°C induced a reduction in survival rate, longevity of adult, number of eggs/female (fecundity) and fertility. The data will be important for predicting dynamic of the fly population and geographical distribution that can assists in the development of anti-flystrategies. The results will be important to predict the fly'spopulation dynamics and geographical distribution, which would help develop the fly control strategies.

Keywords: *Musca Domestica*, Temperature, Moisture (Relative Humidities), Larval Densities, Development, Mortality, Longevity, Fecundity, Fertility

1. Introduction

M. domestica is a major pest in livestock production facilities that particularly the poultry houses [1, 2]. *M. domestica*, is the medical important insects, is being mechanical transport of all of the pathogens (e.g., virus, bacteria, protozoa, helminth eggs) that could cause disease and disease in people and animals of domesticated [3]. *M. domestica* representing pest of major economic significance and pollution of animal products, poultry, and livestock the transfer of the wide range of animal pathogens [4]. The continued success of *M. domestica* in different parts of the world can be explained by at least two important factors, a high growth rate and short life cycle [5-7]. Diptera influenced by multiple biological agents (temperature, moisture) and numerous vitala gents (Normalenemies) [8]. Temperature affects a number of major events in the reproductive performance, especially fecundity [9-11]. Carroll and Quiring [12] found that the potential fecundity (number of eggs matured) and realized fecundity (number of eggs lay) are both of which influenced by temperatures. Temperature is an important ecological agent for *M.domestica* population growth, particularly in the equatorial and tropical zones, where there is a high density of the species [13]. The temperature was considered to impact the history of insect life, including *M. domestica* [14]. The velocity and length of larval development of many pests were influenced through a chain of endogenous and exogenous factors [15]. But the temperature is a specially important abiotic factor as it directly impact for deaths and development duration [7]. Ecological conditions have been linked with a significant difference in all of characteristics of adult and immature stage of insects, such as larval growth rates, development times,and longevity [16].Temperature and moisture have the maximum dramatic effect on the breeding and laying eggs in arthropods [17-20]. Most insects have

arrange of moisture preferred which are relatively inactive [21, 22]. It was found in *M. domestica* that at lower temperatures and lengthened life when moisture has been lowered from 80% to 30% [21]. Cloudsley-Thompson [23] noted that increased longevity of adult with increased relative humidity of 40%-90%. Scientists indicated that temperature is the major abiotic consider influencing survival and development of a lot of Muscaidae species [24-28].

Survival rates and development of *Tgranarium*, significantly depends on temperature, light, moisture, season, and host species [29-31]. Development and survival rates of *T.granarium*, significantly depends on temperature, light, moisture, season, and hosts pecies [29]. Several studies have demonstrated that higher the temperature significantly reduce longevity and fecundity of parasitoids [32, 33].

The aim of the current study was to assess the development of *M.domestica* in different temperatures, humidity and larval density and also ,the impact different temperatures on survival, longevity ,Fecundity and fertility of adult *M. domestica*

2. MaterialandMethods

2.1. Breeding of M. Domestica

Insect stock colony: Adult of *M. domestica* were gathered from a farm in Jeddah Saudi Arabia, using a sweep net, and have brought to the laboratory. The pests has been identified next the taxonomic keys *M. domestica* , they were moved into a small cage (40×30×30 cm). The pest was raised following the systematic, for three generations without pesticide exposure in order to get the newborn generations of larvae [34].

Used cotton immersed in condensed milk and sugar (01:01), and water. For feeding the adults. Moreover, containing milk powder, sugar, wheat bran ratio of (0.3: 0.3: 4) by weight, respectively for feeding spawning and the premature development. Flies were brought up under the standard laboratory conditions: 25±2°C, 60±5% RH. Flies after the eight generations were graded as the laboratory colony and used to evaluate the biological studies.

2.2. Biological Study

2.2.1. Effect Different Temperature, Moisture (Relative Humidity) and Larval Densitieson Mortality and Development Time of M. Domestica

The transfer of insect from laboratory culture, maintained at 25°C and 75% relative humidity, and remains under constant, dark conditions. The artificial oviposition substrate was containing milk powder, sugar, wheat bran ratio of (0.3: 0.3: 4) by weight), water, respectively In the cages of rearing where the female lay eggs the artificial oviposition substrate has been removed and put them in environment room in a plastic petri dish (6.0 cm diameter× 1.5 cm deep).

To examine the effects of temperature on the mortality of the larvae, the developmental time for all life stages of *M. domestica*.The experimental technique was used for constant temperature (20, 25, 30, 35°C) at 75% RH and exposure for 24 hours and four repetitions, each made up of the 25 eggs, larvae, pupae and adults and putitinan environment room in a plastic petridish.

To study the impact of moisture (relative humidity) on the mortality of larvae, the developmental time for all life stages of *M. domestica*. The experimental technique was used relative humidities of 12, 52, 75 and 98%. At constant temperature 25 °C for 24 hours and four repetitions, each made up of the 25 eggs, larvae, pupae and adults and put it in an environment room in a plastic petri dish. Has been obtained different humidity values through the use of saturated salt solutions as reported by Winston and Bates (I960); KgSO ^ yield 98%, sodium chloride and the yield of 75%, and sucrose in addition to urea yielding 52%, and LiCl - H_2O yield relative humidity 12% (t. h).

These solutions have put in the bottom of the fourth in one of the plastic tightly of moisture rooms, at a depth of 4 cm. These moisture rooms were made with a network platform screen and placed 2 cm above the brine. With a covered container, has been reached on the value of moisture needed within about 30 minutes. Five plastic cups 5 ml, while providing a similar cereal with those used in breeding colonies, put on the network platform and provide containers for holding experimental animals during testing procedures. Investigations carried out in all phases growths.

To study the impact of four larval densities, 100, 400, 600, and 1000, on the mortality of larvae, the developmental time for all life stages of *M. domestica*. The experimental technique was used for larval densities, 100, 400, 600, and 1000 at constant temperature 25°C, 75% RH and exposure for 24 hours and four replicates.

2.2.2. Effect of Different Temperature on Survival Rate, Longevity, Fecundity and Fertility of M. Domestica

It held 100 adults (male and female) in the 4-liter network-top plastic containers in every four constant temperatures (20, 25, 30, 35°C) in incubators at 75 RH. Thus, it was created three replicates at each temperature during the 24-hour period. Each container was sleeve knitted cotton to get to the recovery of dead flies and dishes Exchange foodstuffs. The food was diluted evaporated milk and Habibiya of sucrose in a discrete petri dish. Server the two cotton platforms in a dish of milk as a substrate to lay eggs. In 20, 25, 30, and 35°C, and the rate of survival and fertility data brought each 12 hours for the first 11 days and every 24 hours subsequently until all were dead flies in each container.

The data of Fecundity were collected by eliminating milk bowl,wash all the eggs from cotton cushion on a fine mesh screen, and checking panel under a dissecting microscope to ensure that all the eggs have been removed.

The estimated survival as the number of the adults arising out from each vial. Meaning longevity was computed for each gender in each temperature by multiplying the number of flies that died daily by the number of days they were living, to summarize these values, and dividing Prime number of flies. The age at which laying eggs occurred was awarded by multiplying the number of eggs laid each day from the day of egg-laying, summarize these values, and dividing the total

number of eggs laid. The average number of eggs was observed in females account (fecundity) at each temperature calculated by dividing the total number of eggs was observed on the whole experience was Prime number of females. Fecundity has been measured by calculating the egg number per female also expressed average eggs a day

To determine fertility, two or three patches having not less than 100 eggs were collected during the first 3 days of the ovipositor and incubated under the laboratory conditions until hatching and the percentage of hatchability was recorded.

3.Results

3.1. Effect Temperature on Mortality, Development Time of Different Developmental Stages of M. Domestica

The present data showed that there are no significant differences in the mortality of stage of eggs in different temperature, while there are significant differences in the first, second, third and fourth instar larvae at a temperature of 35°C, However, pupa mortality was highly significant affected at 35°C. The adult stage was not affected by different temperatures (Table 1). The data found in Table 1 pointed out that the temperature had a significant impact on development time of all immature and adult stages. Development from egg to adult declined with increasing temperature and time of the first development stage to adult was shorter at 35°C, and the longest at 20°C. The larval duration decreased significantly at 35°C for the second, third and fourth larvae, while the adult (male and female) was not affected at temperatures under 35°C. The present results indicate that 25°C is the temperature nonstressful for these species.

Table 1. *Effect of different constant temperatures on mean mortality and the development time in days of M. domestica.*

Stage	Temperature(°C)							
	20		25		30		35	
	Mean mortality	Developmental time	Mean mortality	Developmental time	Mean mortality	Developmental time	Mean mortality	Developmental time
Egg	0.00±0.00^{ns}	1.02±0.22^{ns}	0.00±0.00^{ns}	1.00±0.43^{ns}	0.01±0.00^{ns}	0.70±0.11*	0.01±0.00^{ns}	0.50±0.13*
1stinstarelarva	0.02±0.13	1.08±0.10	0.03±0.12	1.04±012	0.10±1.13*	1.00±023*	0.13±1.13*	0.07±1.00**
2ndinstarlarva	0.03±0.76^{ns}	2.031±0.30	0.04±0.16^{ns}	2.00±1.22	0.11±0.13*	1.66±0.67**	0.15±0.13*	1.03±0.34**
3rdinstarlarva	0.01±0.22^{ns}	2.90±0.56	0.03±0.01^{ns}	2.04±0.37	0.16±0.06*	1.76±1.13**	0.18±0.06*	1.21±0.22**
4thinstarlarva	0.14±0.13^{ns}	3.43±0.53	0.13±0.18^{ns}	3.31±0.02	0.17±0.16^{ns}	2.34±0.11**	0.19±0.16^{ns}	2.10±1.23**
Pupa	0.18±0.22^{ns}	4.58±0.11	0.17.03^{ns}	4.22±0.87	0.19±0.11^{ns}	3.12±0.65**	0.20±0.11^{ns}	3.05±0.45**
Adult	0.20±0.14	17.2±0.21	0.21±0.23	17.00±0.44	0.22±0.17	16.88±1.32^{ns}	0.22±0.17	16.87±0.45**

*significant difference, **highly significant (significant difference at the 5%level).

3.2. Effect of Relative Humidity on Mortality and Development Time of Different Developmental Stages of M. Domestica

The present data showed that there are no significant differences in the mortality of the stage of eggs in different relative humidity while there is a significant difference in the mortality of all immature and adult stages. Low extremes in relative humidity up to 12% or up to 98% at the optimum temperature (25°C). Also, the data show there was no significant overall mortality at 25°C under moisture levels of 52% - 75%. The present data showed that in relative humidity (12% or 98%) development time for the first, second, third, fourth instar larvae and pupa significant increased, However, the time needed for the development of the adult was very influenced significantly, the data show there was no significant in development time of all immature and adult stages at 25°C under moisture levels of 52% - 75%. The present results indicate that conditions of humidity 52% - 75% RH is the nonstressful moisture conditions at 25°C for this species.

Table 2. *Effect of relative humidity on mean mortality and the development time in days of M.domestica.*

\	Relative humidity(%)							
	12		50		75		98	
	Mean mortality	Developmental time	Mean mortality	Developmental time	Mean mortality	Developmental time	Mean mortality	Developmental time
Egg	0.03±0.02^{ns}	1.10±0.12^{ns}	0.00±0.00^{ns}	1.00±0.43^{ns}	0.01±0.04^{ns}	1.01±0.51^{ns}	0.05±0.04^{ns}	1.12±0.43^{ns}
1stinstarelarva	0.13±0.21^{ns}	1.5±018^{ns}	0.03±0.12^{ns}	1.04±012^{ns}	0.05±0.14^{ns}	1.06±016^{ns}	0.16±0.21^{ns}	1.20±014^{ns}
2ndinstarlarva	0.17±0.16^{ns}	3.20±1.22^{ns}	0.04±0.16^{ns}	2.00±1.22^{ns}	0.07±0.12^{ns}	2.50±1.15^{ns}	0.21±0.17^{ns}	3.60±1.2^{ns}
3rdinstarlarva	0.18±0.12^{ns}	3.30±0.14^{ns}	0.03±0.01^{ns}	2.04±0.37^{ns}	0.05±0.12^{ns}	2.08±0.13^{ns}	0.20±0.12^{ns}	3.80±0.24^{ns}
4thinstarlarva	0.21±0.21^{ns}	4.21±0.40^{ns}	0.13±0.18^{ns}	3.31±0.02^{ns}	0.16±0.12^{ns}	3.52±0.13^{ns}	0.31±0.32^{ns}	5.23±0.32^{ns}
Pupa	0.34±0.32^{ns}	6.32±0.64^{ns}	0.17±0.03^{ns}	4.22±0.87^{ns}	0.18.±004^{ns}	4.54±0.34^{ns}	0.45±0.53^{ns}	8.44±0.27^{ns}
Adult	0.46±0.23^{ns}	20.14±0.61^{ns}	0.23±0.23^{ns}	17.00±0.44^{ns}	0.26±0.35^{ns}	18.10±0.44^{ns}	0.52±0.61^{ns}	25.12±0.33^{ns}

*significant difference, **highly significant (significant difference at the 5% level).

3.3.Effect of Larval Density on Mortality and Development Time of Different Developmental Stages of M. Domestica

Data are presented in (Table 3) showed that mortality from egg to adult was significant increasing with increasing immature density. Mortality of 1st instare larva and adult is 0.05±0.17and 0.25±0.16, respectively at 100 densities Also, 1st instare larva and adult is 0.32±0.33 and 0.50±0.42, respectively at 500 density. Data contained in (Table 1) indicated that the larval density was highly influential at the time required for the development of all immature stages and adult. It was increased developmental period from egg to adult with increased density of larvae. The time required for the development of the first stage to adult shorter at 100 densities and the longest at 500 densities.

Table 3. *Effect of density on mean mortality and the development time in days of M.domestica.*

	Larval Density							
	100		300		600		1000	
	Mean mortality	Developmental time	Mean mortality	Developmental time	Mean mortality	Developmental time	Mean mortality	Developmental time
Egg	0.01±0.01^{ns}	1.10±0.43^{ns}	0.21±0.12^{ns}	2.54±0.12^{ns}	0.30±0.22^{ns}	4.21±0.22^{ns}	0.35±0.32^{ns}	5.33±0.43^{ns}
1stinstarelarva	0.04±0.11^{ns}	1.12±011^{ns}	0.13±0.21^{ns}	3.33±0.21^{ns}	0.23±0.11^{ns}	5.12±0.11^{ns}	0.32±0.33^{ns}	6.33±0.12^{ns}
2ndinstarlarva	0.05±0.17^{ns}	2.10±1.32^{ns}	0.17±0.13^{ns}	4.62±1.42^{ns}	0.26±0.12^{ns}	5.82±1.52^{ns}	0.42±0.15^{ns}	7.21±1.23^{ns}
3rdinstarlarva	0.04±0.11^{ns}	2.14±0.27^{ns}	0.18±0.22^{ns}	5.11±0.17^{ns}	0.28±0.32^{ns}	6.23±0.18^{ns}	0.32±0.21^{ns}	8.11±0.16^{ns}
4thinstarlarva	0.14±0.12^{ns}	3.36±0.12^{ns}	0.24±0.21^{ns}	6.22±0.21^{ns}	0.30±0.11^{ns}	8.56±0.22^{ns}	0.45±0.12^{ns}	10.4±0.33^{ns}
Pupa	0.18±0.13^{ns}	5.12±0.87^{ns}	0.28±0.17^{ns}	8.16±0.19^{ns}	0.35±0.17^{ns}	9.43±0.23^{ns}	0.43±0.18^{ns}	11.2±0.44^{ns}
Adult	0.25±0.16^{ns}	18.10±0.14^{ns}	0.32±0.33^{ns}	20.33±0.21^{ns}	0.41±0.21^{ns}	23.14±0.21^{ns}	0.50±0.42^{ns}	26.21±0.32^{ns}

*significant difference,**highly significant (significantdifferenceatthe5%level).

3.4. Effect of Different Temperature on Survival Rate, Longevity ,Number of Eggs/Female(Fecundity) and Egg Hatching (Fertility)of the Adult of M. Domestica

The data contained in table 4 showed that the temperature had a great influence on the survival rate, longevity, and the number of eggs / female (fertility) and the eggs hatch (fertility) of adults. Current results noted that the survival rate and longevity of adults reduction with the increase in temperature from 20°C to 35°C. Survival rate ranged from 88±1.22 at 20° to 58 ±0.22 at 35°C while the mean longevities of adult ranged from 45.2± 0.51 at 20° to 13.6± 1.8 at 35°C. In addition, decreased the number of eggs/female (fecundity) and Egg hatching (fertility) with increasing temperature from 20° to 35°C. Number of eggs/female (fecundity) ranged from 548.2±41.7at 20° to186.8±42.5 at 35°C and fertility ranged from 34.8±1.8 at 20°C to 8.8±12.3 at 35°C. The results tabulated in Table 3 indicated that different temperature from 20° to 35°C induced a reduction in survival rate, fecundity of adult, number of eggs/female (fecundity) and fertility.

Table 4. *Effect of different constant temperatures on survival rate, longevity, ,fecundity and fertility against female adults of M.domestica.*

Temperature(°C)	Survival rate	Longevity	No. of eggs/female(fecundity)±S.E	Egg hatching (fertility)%±S.E
20	88±1.22	45.2±0.51	548.2±41.7	34.8±1.8
25	82±0.43*	31.2±4.5*	545.6±33.8	32.6±4.6
30	68±0.65*	19.6±1.6**	332.2±22.1*	14.2±1.4**
35	58±0.22**	13.6±1.8**	186.8±42.5**	8.8±12.3**

*significant difference,**highly significant (significant difference at the 5% level).

4. Discussion

The current results pointed that the temperature was a significant effect on mortality and the time required for the development of all immature stages and adult. The current data pointed the temperatures from 20 to 25°C have all the earmarks of being the most appropriate for the egg, larva and pupa development. The development time of all stages became shorter with the increasing temperature this results agree with Duyck and Quilici [25] found that the larval duration of Ceratitis capitata was shorter when the temperature increasing to 30 °C. Gilles et al., [35] pointed that the mortality of the immature stages of two species of dipteran insects Stomoxys calcitrans and Stomoxys niger was lowest at 20-25°C and increased strongly at 15 and 35°C and also, development time was reduced with high temperatures of 15°C to 30°C. This result is supported by Liu and Ye [27] indicated that the average survival of Bactrocera correcta maximum of 24-33°C decline in the degree of above or below temperatures, and the time required for the development of the egg, larva and pupa significantly reduced when the temperature passed 18-33°C. Lü and Zhang [36] pointed out that deaths *S. zeamais* adults increased significantly with increasing temperature up to

43°C, high temperature significantly reduced the larval duration of *S. zeamais*.

The current results noted that there was no significant overall mortality at 25°C below moisture levels of 52% - 75%. Also, the existing data have shown that the development time of the first, second, third, fourth instar larvae and pupa at a relative humidity (12% or 98%) significantly increased, However, the time needed to develop adult was highly significant affected. This agrees with Punzo [37] pointed out that temperatures (10°C and 35°C) does not lead to significant mortality of Enebrio molitor under conditions of relative humidity of 52% and 75%. Thus, 25°C is the degree of heat in nonstressful in all moisture conditions, and 52% and 75% RH. Nonstressful represent humidity levels within temperatures ranging between 10 degrees and 25°C. Data showed that that mortality from egg to adult were significant increasing with increasing immature density and larval density has a significant impact on development time of all immature and adult stages. This result supports by Duarte et al., [38], demonstrated that there was a large increase in the development of *M. stabulans* with respect to the increase in the density of prey and decline in the amount of the substrate and the proportion of food or the impact of density on the survival of *M. stabulans*, is no difference in relation to the amount of the food source, and therefore the interaction between the factors. Also, Duarte et al., [38] the large increase in the development of the testing period with a high density of prey could be explained by an increase in competition interespecific from the first moment of interaction, can drain the substrate significantly before they are preyed upon *M. stebulans* larvae. Moreover, the increase in the time needed to develop adult of *M stabulans* related to the increase in the *M. domestica* density. This can be explained due to the additional spending vital to participate in predatory action, because with a larger number of preys available, there is more time spent dealing with it. Mueller et al., [39] said that the best competitors for limited resources are those who have fled in the shortest period of time. Thus, this drop in mean survival of *M. stabulans* in the percentages with higher prey density was followed by an increase in the average pupal weight, since the mortality least fit individuals must produce a reduction in intraspecific competition. The present results noted that the temperature had a great influence on the survival rate, longevity, and the number of eggs / female (fecundity) and the eggs hatch (fertility) of adults. The survival rate and longevity of adults, number of eggs/female (fecundity) and Egg hatching (fertility) reduces with the increase in temperature from 20° to 35°C. This result agrees with Aung et al., [40] noted that the maximum number of mature egg was largest at 20ºC until day–10 but it gradually reduced significantly with increasing temperature and the longevity of the female parasitoid reduced with increasing temperatures. Huey et al., [41] indicated that the decline in egg production was observed in extreme temperatures can be due to a reduce in the number ovarioles produced at high temperatures, and due to a decline in the number ovarioles produced at high temperatures, shown that the temperature had a significant effect on the longevity of parasites [42-45]. And there was also the influence of the reaction temperature and treatment feed on the longevity of some parasites [11, 46-49] . The present results are also agreeing with the previous studies and the longevity of *O. nezarae* dropped with increasing temperature and the interaction of temperature and food had a significant impact on the longevity. The adopting findings by Apostolos and Robert, [50] pointed out that the low and high extremes of temperatures may reduce their survival, retard their development and / or suppress their reproduction. There are many research indicated that the temperature had a significant effect decreased with increasing temperature on the longevity [46, 48, 51].

5. Conclusion

It can be concluded from this study that different temperature from 20° to 35°C induced a reduction in survival rate, longevity of adult, number of eggs/female (fecundity) and fertility. The data will be important for predicting the dynamics of the fly population and geographical distribution that can assists in the development of anti-fly strategies. The results will be important to predict the fly's population dynamics and geographical distribution, which would help develop the fly control strategies.

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