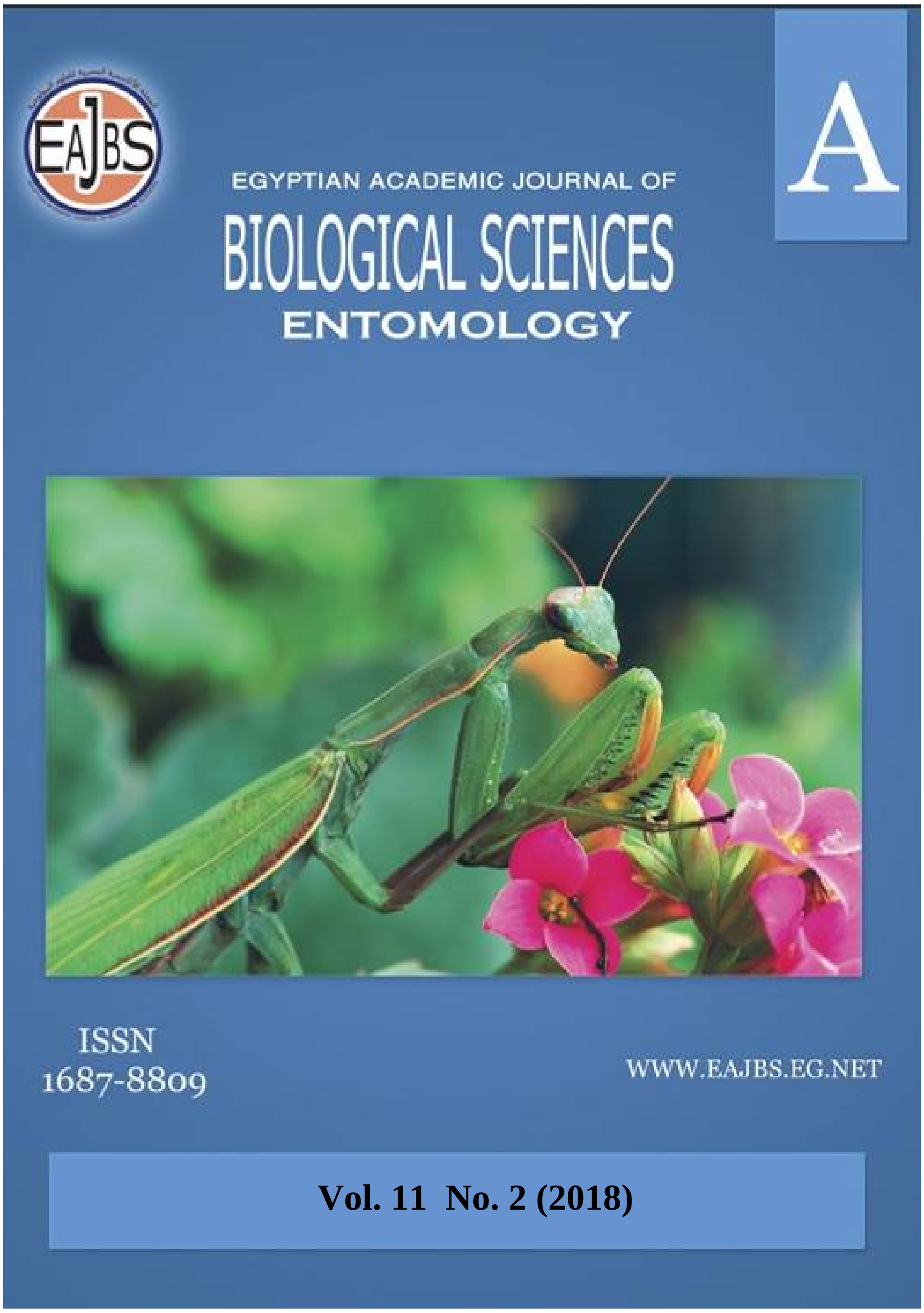


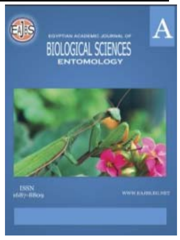
Egyptian Academic Journal of Biological Sciences is the official English language journal of the Egyptian Society for Biological Sciences, Department of Entomology, Faculty of Sciences Ain Shams University.
Entomology Journal publishes original research papers and reviews from any entomological discipline or from directly allied fields in ecology, behavioral biology, physiology, biochemistry, development, genetics, systematics, morphology, evolution, control of insects, arachnids, and general entomology.
www.eajbs.eg.net

Citation: *Egypt. Acad. J. Biolog. Sci. (A. Entomology) Vol. 11(2)pp: 55- 62(2018)*

Egypt. Acad. J. Biolog. Sci., 11(2): 55–62 (2018)

Egyptian Academic Journal of Biological Sciences
A.Entomology

ISSN 1687- 8809
www.eajbs.eg.net



Effect of Certain Physico-Chemical Parameters on the Population Dynamics of Mosquito Larvae and their Correlation with Infected Regions of Filariasis in Alkorin Village, Sharkia Governorate (Egypt)

Arafa N. El-Naggar[1], Shereen M. Elbanna[2], Mona F. Kaiser[3], Refaat M. Gabre[4*]
1- Sharkia section, Egyptian Ministry of Environment, Egypt.
2- Department of Zoology, Faculty of Science, Suez Canal University, Ismailia, Egypt.
3- Department of Geology, Faculty of Science, Suez Canal University, Ismailia, Egypt.
4- Department of Entomology, Faculty of Science, Cairo University, Giza 12613, Egypt[*].
Email: rgabre@sci.cu.edu.eg

ARTICLE INFO
Article History
Received: 29/2/2018
Accepted: 30/3/2018

Keywords:
Physic-chemical parameters, Mosquito larvae, larval density index, Filariasis, Egypt

ABSTRACT
Different watercourses act as breeding habitats for mosquito larvae, thus responsible for the spread of certain diseases. This study examined the effect of certain physico-chemical parameters (temperature, turbidity, pH and salinity) on the population dynamics of mosquito larvae dispersed in the infected regions by filariasis in Alkorin village, Sharkia, Egypt during 2015 and 2016. Larval density index (LDI) was used to examine the population dynamics of mosquito larvae distributed in the studied areas (27 sites in 6 watercourses). During the study, LDI of *Culex pipiens pipiens* was the highest percentage (76.4%). Meanwhile, LDI for other mosquito larval species were (12%, 7%, 3%, 1% and 0.6%) for (*Cx. antennatus, Cx. perexigus, Cx. pusillus, Cx. univittatus and Cx. sinaiticus*), respectively. The maximum rate of LDI for *Cx. pipiens* larvae was observed in autumn 2015 at all the sampling sites and a significant positive correlation of temperature and turbidity with the larval population ($P < 0.05$) was achieved. Salinity and pH had no significant effects ($P > 0.05$) on the larval distributions of different species.The present data may be concluded that the high LDI of *Cx. pipiens* is an interpretation for the transmission of filarial diseases in Alkorin village, Sharkia, Egypt.

INTRODUCTION

Culex mosquito has been implicated for the transmission of Lymphatic Filariasis (Yerpude *et al.*, 2013). The illness elephantiasis was caused by a filarial worm and transmitted by mosquitoes of Culex variety (Wilke, 2009). These ailments cause mortality or bleakness among people as well as social, social, natural and financial loss of the general public (Ghosh *et al.*, 2013).

In various kinds of waters with an extensive variety of territories mosquitoes breeds were dispersed. The determination of the reproducing locales dictated by physical and substance properties of the water (Seghal and Pillai, 1970).

Temperature is the most important factor influencing for larval survival, but larval growth is stimulated as temperature increases (Douroudi *et al.*, 1999). Temperature likewise follows up on the digestion by the general increasing speed of every single metabolic capacity, similar to breathe and ingestion (Rico-Villa *et al.,* 2009). For designing a vector control strategies, ecological physical characteristics of the breeding habitats and environmental factors affecting mosquito larval abundance were essential for control plan strategies (Overgaard *et al*., 2001). Understanding factors of temperature and turbidity influencing mosquito larvae is important to control vector distribution and abundance (Jemal and Al-Thukair, 2016).

This study examined the ranges of temperature, turbidity, pH, and salinity of mosquito larval habitats with the relation of particular mosquito species abundance in Alkorin region, Sharkia, Egypt.

MATERIALS AND METHODS

The study was carried out in Summer 2015, Autumn 2015, Spring 2016 and Winter 2016 in Alkorin region, Sharkia Governorate, Egypt. The study sites located within the latitude of 31.7816 - 31.7843 N and longitude of 30.6369 - 30.5856 N. It is located between Lake Manzlah from the north, Ismailia from the east, Qalyubiah and Cairo Governorate from the south and Daqahliyha Governorate from the west. The study area includes twenty-seven sites distributed in six ponds (Alkorin drain1, Alkorin drain2, Assaidiyah canal, Aljadidah canal, Qunri canal and Alkorin drain3) with length (4.7 km, 4.3 km, 7.1 km, 5.4 km, 8.5 km and 6.5 km), respectively. The study area is semi-shaded with average width from 3 to 6m (Fig. 1).

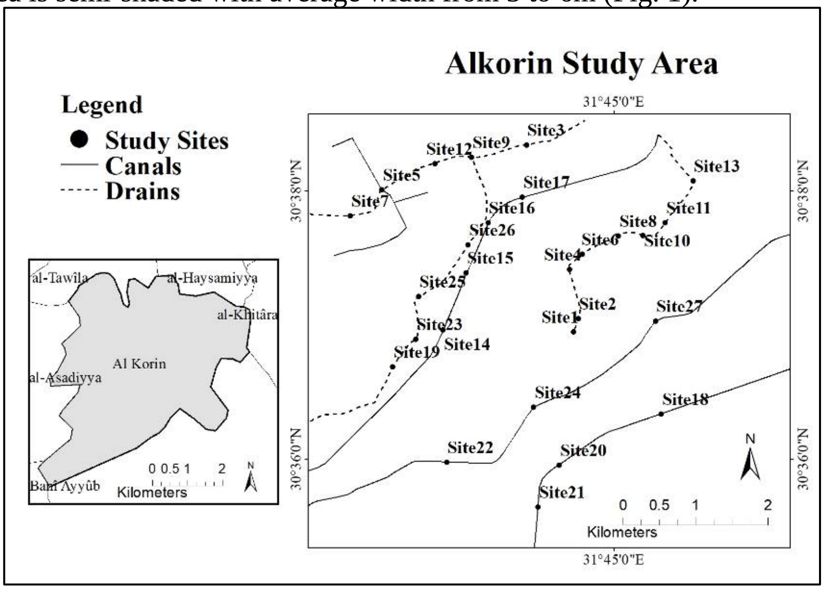


Fig. 1: Location of study area and sites of collection.

Collection of mosquito larvae and water samples were done at seasonal intervals from July 2015 to April 2016. Larvae were collected by sweeping the surface water according to (WHO, 1975). Mosquitoes larvae were identified morphologically according to the key of Kirkpatrick (1925) and Harbach (1988) for the Egyptian mosquitoes.

During the present study, the temperature was measured using mercury thermometer and turbidity was measured by turbidity tube which expressed by NTU (Nephelometric Turbidity Unit). While, pH was measured by Gondo pH pen (model 5011) and salinity (ppm) was measured by salinity pen (model AZ8371).

After the identification, larval density index (LDI) was calculated for each mosquito species by using the formula of Kocher and Dipti, 2014 as following:

$$LDI\% = \frac{\text{Number of larvae of on specific type}}{\text{Total number of larvae}} \times 100$$

Statistical Package for the Social Sciences (SPSS) (version 18, 2009) computerized program was used for statistical analysis. Means, standard deviations, and standard errors, were calculated for larval densities of mosquitoes. To examine the relationship of the density of larvae with some environmental factors of the reproducing water localities, multiple regression analysis was used.

RESULTS

Figure 2 shows the number of mosquito larvae collected during two successive years (2015- 2016). The total number of *Cx. pipiens* larvae was 4749 and there are two peaks of populations during winter, 2015 and spring, 2016. The samples showed *Cx. pipiens* larval population density at its highest level during October, 2015 was “1152” and during April, 2016 was “845”. While the lowest *Cx. pipiens* larval population during December, 2015 was “2” and during January, 2016 was “5”. *Cx. pipiens* larval abundance increased directly ($P < 0.05$) with water temperature (Fig. 3) in Autumn and Spring as P-value (0.001, 0.042), respectively. It correlates significantly with test score, $r (25) = (0.684, 0.393)$. Water temperatures had a weak effect on *Cx. pipiens* in Summer and Winter, as P-value (0.083, 0.206), respectively.

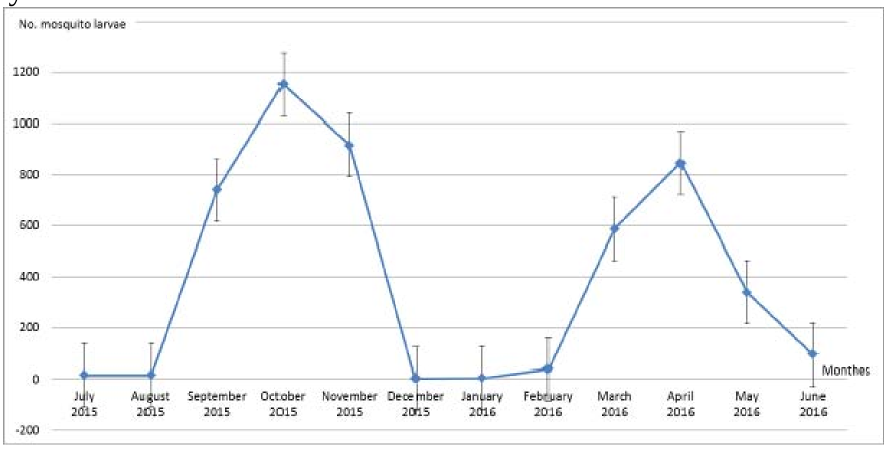


Fig. 2: Mosquito larvae collected during two successive years (2015- 2016).

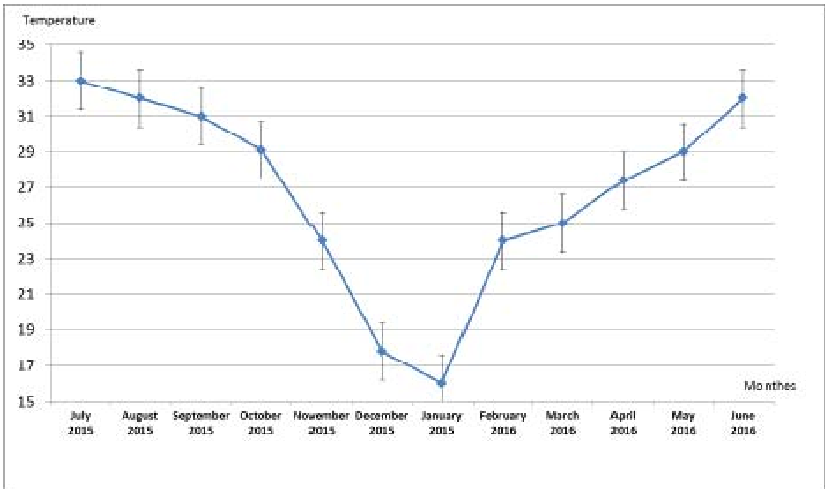


Fig. 3: Water temperature ranges during two years (2015- 2016)

Water turbidity in sites of collection ranged from 114 to 497 NTU. Density of *Cx. pipiens* larval increased directly with turbidity increasing (Fig.4). It correlates significantly ($P < 0.05$) with test score, r (25) = (0.946).

No significant differences ($P > 0.05$) were recorded either for pH (6.6 to 7.5) nor for salinity (340 to 810 ppm) of the water breeding habitats of mosquito larvae was determined from all the sites of mosquito larvae collection.

It is obvious that the LDI of *Culex pipiens pipiens* was the highest percentage (76.4%). Meanwhile, LDI for other mosquito larval species were (12%, 7%, 3%, 1% and 0.6%) for (*Cx. antennatus*, *Cx. perexigus, Cx. pusillus, Cx. univittatus and Cx. sinaiticus*), respectively (Fig. 5).

Out of twenty seven sites that were selected in six watercourses for the larvae collection, only two watercourses showed no record for mosquito larvae (Aljadidah canal and Alkorin drain3). Meanwhile, the highest percentage of *Cx. pipiens* were recorded in Alkorin drain1 (48.2%) and Alkorin drain2 (38.4%). Consequently, these two sites were recorded as the most infected regions by filaria.

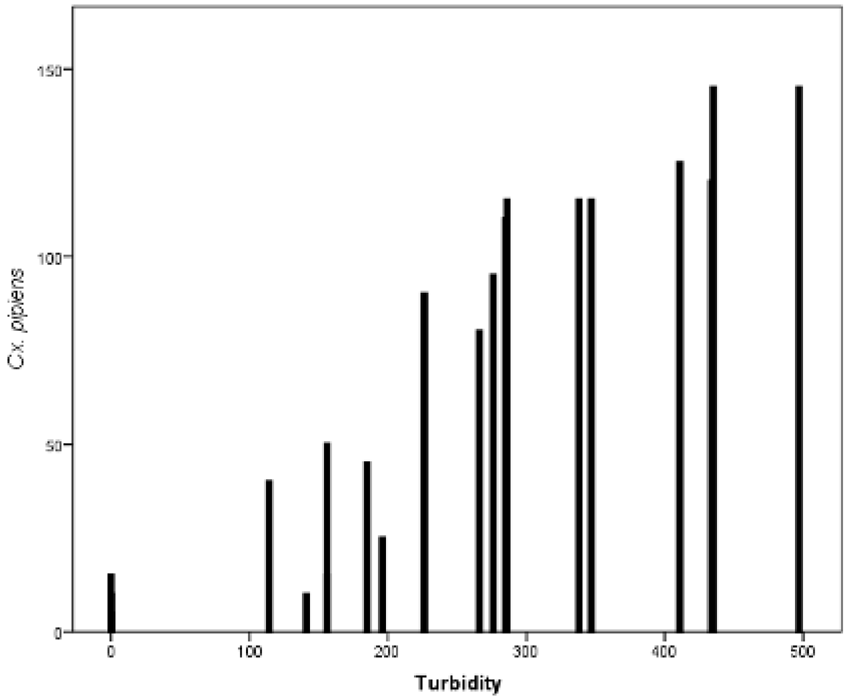


Fig. 4: Relation between turbidity and *Cx. pipiens*

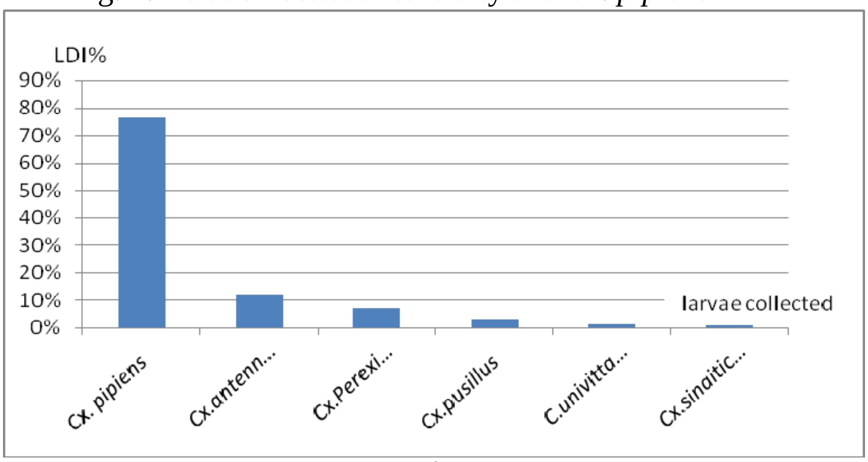


Fig. 5: Total number of larvae collected and LDI

DISCUSSION

Population dynamics of *Cx. pipiens* are influenced by several factors. Mosquito larvae are highly dependent on ambient water temperature for successful development. Results indicated that, *Cx. pipiens* was the most common at autumn 2015 and Spring 2016, while the most appropriate water temperature ranged from 27 to 33 ^{o}C (29.11 ± 0.351). WHO (1975) announced that the normal ideal temperature for the advancement of most mosquito hatchlings species is around 25-27°C. The development and growth of mosquito larvae were affected by temperature which acts as the main factor (White, 1974). Quicker advancement of mosquitoes oceanic stages comes about because of increment in water temperature, yet developing grown-ups will diminish in their sizes (Bayoh and Lindsay, 2003) at higher temperatures mortality expanded then fewer grown-ups are created (Bayoh and Lindsay, 2004). In past examinations at a few Egyptian Governorates mosquitoes hatchlings gathered from various temperature ranges, for example, 21 to 29 oC (Kenawy *et al*., 1998) and 17 to 30oC (Kenawy *et al*., 2013). Hassan *et al.*, (2016) detailed that densities of all species were specifically identified with temperature, except for *Cx. quinquefasciatus* and *Cx. tritaeniorhynchus*. Nonetheless, in the Eastern Province, Jemal and Al-Thukair (2016) watched that mosquito larval wealth has a negative relationship with temperature (mean correlation coefficient = -0.773 for the whole Province: -0.075 to -0.941 for the 8 study sites). The authors demonstrated that regression model of the 3 climatic factors (temperature, relative humidity and rainfall) represented 64.3% (R= 0.643) of the fluctuation in larval wealth and the staying 35.7% ascribed to different factors, for example, the nearness of vegetation, squander materials and water repositories, for example, trench.

During the present study, the abundance of mosquito larvae was affected directly by increases of turbidity. Sattler *et al*., (2005) reported that culicine larvae were much more expected to be found in turbid breeding sites. Hassan *et al.* (2016) recorded that the turbidity in their study sites reached to (145 NTU) comparing by (400.7 NTU) for *Cx. pipiens* which show the tolerance of highly turbid water, reported by Kenawy *et al.*, (2013). Culicine mosquitoes favor turbid water and breeds successfully in polluted environments such as blocked drains (Chavasse *et al*., 1995). In south India, Sunish and Reuben (2002) researched the relationship of 13 abiotic factors with the plenitude of *Cx. vishnui* immatures in rice fields and showed a positive connection with water temperature.

Our findings, pH, and salinity had no effects on population dynamics of mosquito larvae were confirmed by some authors. Al-Ahmed *et al.* (2010) recommended that the salt substance and pH have no critical impacts on the larval appropriation of the diverse species in Najran. Abdel-Hamid *et al.* (2011a) found that the aggregate larval thickness of *Cx. pipiens*, *Cx. antennatus* and *Cx. perexiguus* decreased as both temperature and pH increased ($P > 0.05$) in El Menoufia Governorate, Egypt. *Kadhem et al.* (2014) demonstrated that *Aedes caspius* had inconsequential positive relationship with pH and temperature, *Culex pipiens* had an insignificant negative correlation with pH and temperature. Hassan *et al.*, (2016) reported that three larval densities of *Cx. quinquefasciatus*, *Cx. theileri* and *St. aegypti* were indirectly related to salinity (b = -0.002 to -0.017) and *Cx. pipiens*, *Cx. theileri*, *Cx. sitiens*, *An. multicolor* and *St. aegypti* were indirectly related to pH (b = -0.13 to -74.57). Meanwhile, several other studies were disagreement with the present work like: Abdel-Hamid *et al.* (2009, 2011b, 2013) in 3 Egyptian Governorates demonstrated that the general larval thickness of *Cx. pipiens*, *Cx. antennatus* and *Cx* *perexiguus* increments as temperature increments (P < 0.05) while it diminishes (P > 0.05) as pH increment. Kenawy *et al.* (2013) showed that densities of both *Cx. pipiens* and *Cx. perexiguus* in Cairo had the positive connection with temperature and pH (P > 0.05) and negative connection with saltiness (P < 0.05). Hassan *et al.*, 2016 found that larval densities of *Cx. quinquefasciatus*, *Cx. tritaeniorynchus* and *Culiseta longiareolata* were straightforwardly identified with pH (b = 2.44 to 23.60) and *Cx. pipiens*, *Cx. tritaeniorynchus*, *Cx. sitiens*, *Anopheles multicolor* and *Cs. longiareolata* were specifically identified with saltiness (b = 0.002 to 0.074). Kenawy *et al.*, (1996) in El Sharkia Governorate, Egypt announced that densities of *Cx. antennatus* and *Cx. perexiguus* altogether (P < 0.05) expanded as a straight capacity of pH and temperature of the reproducing water. Kenawy *et al.* (1998) watched that the connection of larval densities of *Cx. antennatus* and *Cx. perexiguus* were certain with pH and negative with temperature in El Sharkia rice fields, Egypt. Kadhem *et al.* (2014) demonstrated that *Cs longiareolata* had huge negative connection with pH (P < 0.05) and temperature (P < 0.01). Results obtained, also indicated that he highest percentage of *Cx. pipiens* at drains which have water full of food and stagnant. This is in agreement with Abd-El- Magid (1987) recorded that particularly culicine mosquitoes larvae have existed in drainage channels with stagnant water. Filariasis transmitted by *Cx. pipiens* that influenced by increases in temperature, so increases in environmental temperature are expected to speed up development for stages in the parasite life cycle (Gillett, 1974). Distributions of parasite species are limited by environmental restrictions on the development of parasite. But changes in environmental temperature not affected on vertebrate hosts (Dobson and Carper 1992).

CONCLUSION

Biological control strategies for mosquito populations are certainly more ecologically suitable than the use of insecticides. The obtained different ranges of temperature and turbidity in relation to the LDI of the reported larval species may be of help in designing and implementing control program based on environmental manipulation or modifying habitat characteristics that will be effective in controlling targeted mosquito species especially filarial disease vector.

REFERENCES

Abd-El- Magid, A. H. (1987): The susceptibility of different mosquito types in lsmailia Governorate to some insecticides. M.Sc. Thesis (Vector Control), High Institute, of Public Health, Alexandria: 133 p.

Abdel-Hamid, Y. M.; Soliman, M. I. and Allam, K. M. (2009): Spatial distribution and abundance of culicine mosquitoes in relation to the risk of filariasis transmission in El- Sharqiya Governorate, Egypt. Egypt. Acad. J. Biol. Sci., 1: 39-48.

Abdel-Hamid, Y. M.; Soliman, M. I. and Kenawy, M. A. (2011a): Geographical distribution and relative abundance of culicine mosquitoes in relation to transmission of lymphatic filariasis in El Menoufia Governorate, Egypt. J. Egypt. Soc. Parasitol., 41: 109-118.

Abdel-Hamid, Y. M.; Soliman, M. I. and Kenawy, M. A. (2011b):Mosquitoes (Diptera: Culicidae) in relation to the risk of disease transmission in El Ismailia Governorate, Egypt. J. Egypt. Soc. Parasitol., 41: 347-356.

Abdel-Hamid, Y. M.; Soliman, M. I. and Kenawy, M. A. (2013): Population ecology of mosquitoes and the status of bancroftian filariasis in El Dakahlia Governorate, the Nile Delta, Egypt. J. Egypt. Soc. Parasitol., 43: 103-113.

Al-Ahmed, A. M.; Al Kuriji, M. A.; Kheir, S. M.; Al Sogoor, D. A. D. and Salama, H. A. S. (2010): Distribution and seasonal abundance of mosquitoes (Diptera: Culicidae) in the Najran Region, Saudi Arabia. Studia dipterologica, 17:13-27.

Bayoh, M.N. and Lindsay, S.W. (2003): Effect of temperature on the development of the aquatic stages of Anopheles gambiae sensu stico (Diptera: Culicidae). - Bull. Entomol. Res. 93: 375-381.

Bayoh, M.N. and Lindsay, S.W. (2004): Temperature-related duration of aquatic stages of the Afrotropical malaria vector mosquito Anopheles gambiae in the laboratory. - Med. Vet. Entomol. - 18: 174-179.

Chavasse, D.C; Lines, J.D.; Ichimori, K.; Majala, A. R.; Minjas, J, Nm; and Marijani, J. (1995): Mosquito control in Dar es Salaam. II. Impact of expanded polystyrene beads and pyriproxyfen treatment of breeding sites on Culex quinquefasciatus densities. Med Vet Entomol. 1995, 9: 147-154.

Dobson, A.; and Carper, R. (1992): Global warming and potential changes in host-parasite and disease-vector relationships. In *Global warming and biodiversity*, ed. R. L. Peters and T. E. Lovejoy. New Haven, CT: Yale University Press.

Douroudi, M.S.; Southgate, P.S. and Mayer, R.J., (1999): The combined effects of temperature and salinity on embryos and larvae of the black-lip pearl oyster, Pinctada margaritifera. Aqua. Res. 30, 271 – 277.

Ghosh, A.; Mukherjee, S.; Dutta, T.; Roy, S.; and Mondal, F. B. (2013): Community Perceptions Regarding Mosquito Borne Diseases in Some Selected Localities of Bankura, a Peri-Urban Area of West Bengal, India. Journal of Mosquito Research, ISSN 1927-646X, Vol.3, No.7, 54-57.

Gillett, J. D. (1974): Direct and indirect influences of temperature on the transmission of parasites from insects to man. *Symp. British Soc Parasitol*. 12:79.

Harbach, R. E. (1988): The mosquitoes of the subgenus *Culex* in the southwestern Asia and Egypt (Diptera: Culicidae). *Contrib. Am. Entomol. Inst. (ann Arbor)*, 24 (1): 1-240 p.

Hassan, M. I.; Al Ashry, H. A.; Shobrak, M. and Kenawy, M. A. (2016): Field Studies on Mosquitoes (Diptera: Culicidae) in the Western Coast of Saudi Arabia: Influence of Temperature, pH and Salinity of the Breeding Water on Larval Abundance. *Greener J. of Bio. Sc.*, ISSN: 2276-7762, ICV: 5.99

Jemal, Y. and Al-Thukair, A.A. (2016): Combining GIS application and climatic factors for mosquito control in Eastern Province, Saudi Arabia. Saudi Journal of Biological Sciences, in Press, Available on line 13 April 2016, http://dx.doi.org/10.1016/j.sjbs.2016.04.001.

Kadhem, Z. A.; Al-Sariy, J. S. and Ali, S. M. (2014): Seasonal distribution study of mosquito species (Culicidae: Diptera) in Al- Naamania salt Basin north western Al Kut city / Iraq. Wasit. *J. for Sc. & Medicine*., 7: 124-135.

Kenawy, M. A.; Rashed, S. S and Teleb, S. S (1998): Characterization of rice field mosquito habitats in Sharkia Governorate, Egypt. J. Egypt. Soc. Parasitol., 28: 449-459.

Kenawy, M. A.; Rashed, S. S. and Teleb, S. S. (1996): Population ecology of mosquito larvae (Diptera: Culicidae) in Sharkiya Governorate, Egypt. J. Egypt. Ger. Soc. Zool., 21: 121-142.

Kenawy, M. A.; Ammar, S. E.; and Abdel-Rahman, H. A. (2013): Physico-chemical characteristics of the mosquito breeding water in two urban areas of Cairo Governorate, Egypt. *J.* of Entomological and Acarological Research 2013; 45:e17

Kirkpatrick, T. W. (1925): The mosquitoes of Egypt. Egyptian Gov., Antimalaria Commission. Gov. Press, 224 pp.

Kocher, D. K., and Dipti, (2014): Population Dynamics of Mosquito Larvae in Village Ponds and its Correlation with Physico-Chemical Parameters. International Journal of Science and Research (IJSR). 3: 890-894.

Overgaard, H.J.; Tsuda, Y.; Suwonkerd, W. and Takagi, M. (2001): Characteristics of *Anopheles minimus* (Diptera: Culicidae) larval habitats in northern Thailand. Environ. Entomol., 10: 134-141.

Rico-Villa, B.; Pouvreau, S. and Robert, R., (2009): Influence of food density and temperature on ingestion, growth and settlement of Pacific oyster larvae, *Crassostrea gigas*, Aquaculture 287, 395–401.

Sattler, M.A.; Mtasiwa, D.; Kiama, M.; Premji, Z.; Tanner, M. and Killeen, G.F. (2005): Habitat characterization and spatial distribution of Anopheles sp. mosquito larvae in Dar es Salaam (Tanzania) during an extended dry period. - Malaria *J*. 4: 4.

Seghal, S. and Pillai, M.K. (1970): Preliminary studies on the chemical nature of mosquito breeding waters in Delhi. - Bull. WHO. 42: 647-650.

Sunish, I. P. and Reuben, R. (2002): Factors influencing the abundance of Japanese encephalitis vectors in rice fields in India - II. Biotic. J. Med. Entomol., 16: 1-9.

White, G.B. (1974): Anopheles gambiae complex and disease transmission in Africa. - Trans. Roy. Soc. Trop. Med. Hyg. 68: 278-301.

Wilke, A.B.B.; Nimmo, D.D.; John, O. S.; Kojin, B.B.; Capurro, M.L.; and Marrelli, M.T. (2009): Mini-review: Genetic enhancements to the sterile insect technique to control mosquito populations. As Pac J Mol Biol Biotechnol, 17 (3): 65-74.

World Health Organization (WHO) (1975): Manual on practical Entomology in malaria. Part (I): Vector Bionomics and Organization of Anti-Malaria Activities. *WHO Division of Malaria and other Parasitic Diseases*, WHO, Geneva, 160 pp.

Yerpude, P. N.; Jogdand, K.S. and Jogdand, M. (2013): A Study on Awareness and Practice about Preventive Methods against Mosquito Bite among Households in an Urban Slum Area of South India. International Journal of Recent Trends in Science And Technology, ISSN 2277-2812 E-ISSN 2249-8109, Volume 8, Issue 2, 2013 pp 69-71.