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REVIEW ARTICLE
GLOBAL WARMING AND CLIMATE CHANGE : IMPACT ON BIODIVERSITY, PEST MANAGEMENT AND FOOD SECURITY

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Abstract

The global climate changes through the usual climatic conditions such as temperature, wind patterns and precipitation that characterize each region on Earth. When we talk about climate change globally, we mean changes in the Earth's climate in general. The frequency and magnitude of overall climate changes in the long run have tremendous impacts on natural ecosystems. The consequences of global climate change include the spread of agricultural pests and the emergence of new pests and the emergence of changes in the dates of emergence, which affects the decline in the production of agricultural crops, which adversely affect food security. In recent years, many of the impacts of global climate change on the insect environment have been recorded within Iraq's agro-ecosystem, many invasive pests have entered and some of them have changed, and they have caused serious damage to agricultural production. In 2006 there was a widespread outbreak of the Mediterranean fruit fly *Ceratitis capitate*, which caused significant losses exceeding 80% of the citrus crop and some other fruits. In 2010, for the first time, the spread of tomato leaf miner *Tuta absoluta*, which caused extensive destruction of the tomato crop. Between 2011 and 2013, several types of date fruit stalk borer were recorded following the genus Oryctes, which caused severe damage to the palm trees and fruit. In 2016, it was recorded for the first time the spread of fruit fly peach *Bactrocera zonata* in orchards in Iraq. In 2017, for the first time, the spread of the black Mexican insect *Saissetia miranda* was invasive to Iraq's agricultural ecosystem and caused damage to fig trees and fruit. Also recorded in 2018-2019 is the spread of the banded conical snail *Cochlicella barbara*, which is an agricultural pest and a carrier of pathogens of humans and young ruminants. Global climate change has affected the transformation of some species from a non-pest situation into a pest to adapt the climate to their livelihood. It also affected the shift of the level of infection in some pests to the status of the epidemic.

***Keywords*:** Global climate, biodiversity, agricultural pests, insects

Global climate changes and their impact on insect pests

The effects of climate change on our environment are unpredictable, but can be documented with careful study. There are important aspects of global warming and an important effect on warming that play an important role in the evolution of insects by

- Physiology of insects
- Insect Ecology

Globally, insects cause an economic loss of 13.6% annually, in the Arab world, the incidence of agricultural pests caused a loss of 35-50% of the total agricultural production (Firake *et al*., 2013).

In India, the annual economic loss caused by insects is estimated at 17.5% and is valued at $ 17.28 billion in eight crops (cotton, rice, maize, sugar cane, rapeseed, mustard, peanut, legumes and grains), this insect loss is similar to increasing crop diversity with insects caused by global climate change, and a single temperature rise in the Philippines has led to a 10% decrease in rice production. The high average temperature of 6 degrees Celsius led to a decrease in maize production by 36% in the European Union countries (Rosenzweig and Lglesias, 2001).

The Mayfly Ephemera danica is often used as an indicator of environmental quality since the larvae of this insect live in water and are affected by water quality such as pollution, oxygen content, and water temperature. The temperature of the insect's body depends on the temperature of the surrounding environment being cold-blooded, it was found that the rise in water temperature of 1^{o}C in winter and 2 ºC in summer during the last 20 years led to changes in the life aspects of this insect, adults that appear one year later are 8-10 mm smaller than their predecessors, This decrease in the size of the insect has led to fewer eggs because the change in water temperature has made it less adaptable to the new environment and therefore we will either extinct or show new species of Mayflies (Karappaiah and Sajayanad, 2012).

As for mosquitoes, it requires slow-moving water for breeding purposes and one of the reasons for the low population of mosquitoes is low humidity. Stagnant water shortages, climate changes affecting rain, humidity is the most important factor for mosquito expansion rather than temperature. Some important aspects in the life of insects that have been studied globally by their impact on global climate changes:

- Pollinated insects, flowering plants, hibernation, stillness, and plant host.
- Reproductive ability.
- Ability to deploy.
- Interaction with the host.
- Exchange of benefit (pollination of flowers), mismatch occurs between plants and pollinators.
- Mutual harm (competition).
- One-sided utilization (predation or herbivore).

Plant resistance to pests, biocides, natural enemies, synthesis of chemicals related to pest management is changing as a natural consequence of global climate change (6).

Effect of increasing carbon dioxide on the life aspects of some insects (7):

Increase in	decrease in
Rates insect evolution	Food consumption in butterflies
Weighing and lengthening virgins of some tunnel makers	Predatory susceptibility to powders
Response to warning pheromones in aphids	Reproduction of aphids
Fat concentration	Carbon bases for plant defenses against insects
Parasitism	Metabolism of the gypsy moth Saw fly
Effect of gene transfer in the bacteria *Bacillus thuringiensis*	Growth and development of larvae of Saw fly
Nitrogenous bases for plant defenses	Growth and metabolic rate of Wllow beetle
Control of grain aphids using adhesive traps	The weight of the Virgin of the Blue Butterfly
	Nutrition and growth rate of tobacco beetle
	Fertilization and offspring in aphids
	Effect of foliar treatment of the use of bacteria *Bacillus thuringiensis*

Global climate changes and population dynamics of insect pests

Global climate change and global warming are evident in terms of increases in global average temperatures, changes in rainfall pattern, extreme weather events and increased levels of carbon dioxide, and these long-term changes will affect animals and plants and the dynamics of insect pest populations, diversity, activity and abundance of natural enemies, increased crop losses which will affect food security (Petty, 2004).

There are several aspects in this area:

1. Direct effects of climate standards on population dynamics: The effect of upper and lower temperature limits on species in terms of determinants of critical limits of evolution, reproduction, hibernation, death during winter and flight ability (Petty, 2004).
2. Reproduction and development: Insects respond directly and are affected by the conditions of increasing the temperature, especially reproduction and that the rise of heat more than the upper limits of the development of the insect will lead to decreased growth rates and reproducibility and changes in distribution and spread (if the plant host exists). Overheating may result in the mating ability of some insect pests (Sharma, 2012).
3. Hibernation and winter death: The dormant phase of the necessary factors for some types of insects for the purpose of completing their life cycle and to pass the low temperatures in the winter and that the conditions of high temperature may be useful for some species to resist freezing and sometimes not useful for other species that requiring low temperature for hibernation or increased freezing resistance (Samways *et al*., 1999).
4. Migration and movement: The ability of insects to fly is important factors for the spread of herbivorous insects, influencing the timing of the process of mating, the creation of plant host and the formation of insect colonies. The effects of heat on fly vary between species and according to seasons and regions. Each type of insect has temperature limits that affect its ability to fly or change from winged to wingless, such as in aphids, as well as the time of getting out and activity and timing of hibernation. Global climate change has affected many insect pests, their emergence and spread (Dubas Bug, palm borers, *Tuta absoluta* tomato leaf mine) (Khalaf, and Khudhair, 2015; Khalaf and Alrubaei, 2016; Abdul-Razzak *et al*., 2010).
5. The direct effect of increasing the temperature on the insect pests: The rise of temperature may affect any stage of the life cycle of the insect as well as the distribution and spread and survival and reproduction and development (Karappaiah and Sajayanad, 2012).
6. Effect of temperature on survival rate in insects: The effects of temperature during the winter varies from one insect to another, for example increase the number of generations of aphids from 1 - 5 at the temperature of 2 $^{\circ}$C in the winter (warmth), and another type of insects where the laying eggs increase at a temperature of 35 - 40 $^{\circ}$C, but the survival rate of this egg decrease and also less period for pre-laying eggs. In a section of predators, the rise in temperature from 32 to 35 ^{o}C reduces the search period for prey but this decreases after 35 ^{o}C. It was found in some insects that the incubation period of eggs 10 days at the degree of 25 ^{o}C, but amounted to 8 days at the degree of 27 – 28 ^{o}C this, in addition to that the insects do not come out after hibernation unless collected thermal units necessary for its. This has been the subject of thermal unit accumulation as an indication of the emergence of insects to start the application of control programs (Karappaiah and Sajayanad, 2012).
7. Effect of heat on insect growth rate: The rate of pest development is more responsive to changes in temperature. In the green bugs, the number of generations' increases at 2 °C compared to 1 °C. The infection of aphid's changes when there is a change in the thermal units accumulation and when the thermal accumulation unit reach 200 thermal units more attacking plant families (Karappaiah and Sajayanad, 2012).
8. The impact of heat on multi-generations: Climate change is the main cause of changes in the dynamics of pest species and their populations. The first effect of warming is on the number of generations of insects during the year, this relationship is very complicated because it enters the laying egg period, hibernation and other phonological effects (Sharma, 2012).
9. Global warming and the spread of species: this relationship may be positive or negative depending on

the types of pests. In some species the global warming helped to increase their spread and the other species declined or extinct in a certain area (Firake *et al*., 2013).

10. Rainfall and drought: Changes in rainfall in the Sahara have a significant impact on migratory of locusts, and rainfall in summer has a direct impact on soil moisture and drought, especially on insects that spend all or part of their life cycle in the soil surface. The response of root-eating insects increases in dry summer seasons. The conditions of dryness of the soil surface affect the vitality of the eggs of some insects and reduce hatching, especially high drought conditions (Sharma, 2012).
11. Direct effects of climate change on the relationship between insect pests and their plant hosts: The quality of plant nutrients in plant tissue has an effect on plant-feeding insects; this is increased by increasing the nitrogen content, low water levels and concentrations of secondary compounds. The carbon dioxide in the atmosphere is one of the defenses of the plant host and its resistance to the multicultural insect colonies. The nutrition and metabolism of some insect larvae are higher at the level of carbon dioxide between 550 and 700 ppm. As well as the ratio between carbon and nitrogen has the greatest impact on insects with plant nutrition (Samways *et al*., 1999).
12. The impact of climate on the relationship between insect pests and natural enemies: The effects of climate on the relationship between the rate of development of insects and natural enemies, and heat affects the predator search factor for prey and the time of captivity and this effect is indirect. The systems of biological control of insects depends on: temperature, parasites, predators and density of the population of the pest and the success of this system depends on these factors. It was found that the eggs of a predator increases when the attack coefficient increases at the time of catching prey and the temperature increases to 32 C and after 35 C begins to decrease as well as the effects of climate change on the synchronization between the presence of host and prey (Samways *et al*., 1999).

Invasive pests of the agricultural ecosystem in Iraq

In recent years, many invasive insect pests of the agricultural ecosystem in Iraq have been recorded:

(1) **Mediterranean fruit fly *Ceratitis capitata***: This pest spread in orchids during 2006 and caused great damage in the fruits of citrus fruits, apricots, persimmons and some other fruits (Al-Jboory, 2007).

Fig. 1 : Infestation of Mediterranean fruit fly larvae *Ceratitis capitata*

(2) Tomato borer *Tuta absoluta*: This pest entered the Iraqi environment during 2010 has caused great damage in the production of tomato crop was entering the Iraqi environment is the first registration of this pest in the agricultural ecosystem in Iraq (Abdul-Razzak *et al*., 2010).

Fig. 2 : Tomato borer *Tuta absoluta* infection in greenhouses.

(3) Palm borers: In 2013, for the first time, several species were recorded and under the types of palm borers follow the genus Oryctes, while only one species was registered since 1911, these types cause damage to palm trees and fruit and transmit pathogens from the affected palm to the healthy plants (Khalaf *et al*., 2012; Khalaf *et al*., 2013; Khalaf and Al-Taweel, 2015).

Fig. 3 : Adult and larval palm borer of the genus Oryctes, the damage caused to palm trunks.

(4) Peach fruit fly *Bactrocera zonata*: Record of the spread of this pest in the agricultural ecosystem in Iraq during 2016, this pest caused serious damage to the fruits of peaches and other fruits of almonds, it was considered an invasive pest of the agricultural ecosystem in Iraq (Abdul-Razzak, 2016).

Fig. 4 : Adult and larva of Bactrocera zonata peach fly

(5) Mexican black scale, (*Saissetia Miranda*): Record of the entry of this pest to the Iraqi environment during 2017, and its spread on fig trees, which caused damage in the trees and fruits, As indicated entry from neighboring countries of Iraq, note that it is registered for the first time in the agricultural ecosystem in Iraq has been considered a pest invasive to the Iraqi environment (Khalaf *et al*., 2019).

Fig. 5 : Eggs and adult insects of black Mexican insect *Saissetia miranda*.

(6) Banded Conical Snail (*Cochlicella Barbara*): This snail record in 2018 - 2019 as the first recording in the Iraqi environment, This snail is an agricultural pest on grain crops, especially wheat, which leads to poor quality and not suitable for human consumption and not suitable for export. Due to the entry of snails through harvesting machines because the size is close to the size of wheat grains, therefore rejects consignments containing this type of snails (Al-Doori *et al*., 2018; Khalaf *et al*., 2019). The health hazard of this snail lies in the fact that it is an intermediate host of a threadworms that transmits pathogenic bacteria that cause respiratory diseases to the humans and young ruminants (Khalaf *et al*., 2019).

Fig. 6 : Banded Conical Snail (*Cochlicella Barbara*)

Conclusions and Recommendations

Through the researches and studies carried out on invasive pests of the agricultural ecosystem in Iraq and changes in the dynamics of endemic pests it is clear that there is a change in the dates of their appearance and the disappearance of another pests and some of them turned to the level of the epidemic. This is evidenced by the impact of changes in the global climate and the lack of an effective quarantine and border control system.

From it we can recommend:

- Adopt an effective quarantine system at border entry points and permanent border controls to limit the entry of shipments of agricultural crops and food containing quarantine pests.
- Adopt a sophisticated surveillance system at border points for neighboring countries likely to enter pests to Iraq.
- Relying on specialists with experience in border crossing points for the purpose of screening agricultural crops

that are likely to be infected with pests that are not present in the Iraqi environment.

- The Ministry of Planning puts within the investment plan financial allocations to cover the completion of investment projects in the field of invasive pests and pests coming to the Iraqi environment and the impact of global climate changes on the dynamics of insects in the agricultural ecosystem in Iraq.

References

Abdul-Razzak, A.S. (2016). New and invasive pest. Arab and Near East Newsletter (ANEPPNEL). No 69. P4.

Abdul-Razzak, A.S.; Al-Yasiri, I.J. and Fadhil, H.Q. (2010). First record of tomato borer, *Tuta absoluta* on tomato crop in Iraq. Arab and Near East Newsletter (ANEPPNEL). No.51: 31.

Al-Doori, N.L.; Al-Doori, M.L. and Al-Juburi, H.Q. (2018). A first record and developmental stages of an exotic species *Cochlicella barbara* (Linnaeus, 1758) (Gastropoda: Cochicellidae) in Iraq, Baghdad. J. of. Global Pharma Technology, 10(07): 104-107.

Al-Jboory, I. (2007). New record of Mediterranean fruit fly in Iraq, Arab and Near East Plant Protection Newsletter, Arab Society for Plant Protection and Near East Regional Office of the FAO, 36-37.

Firake, D.M.; Behere, G.T.; Azad Thakur, N.S.; Burange, P.S. and Bharamble, V.Y. (2013). Climate change and insect pests: Potential impacts and future strategies, popular Kheti, 1(2): 7-70.

Karappaiah, V. and Sajayanad, G.K. (2012). Impact of climate change on population dynamics of insect pests. World J. of Agricultural Sciences, 8(2): 240 -246.

Khalaf, M. and Khudhair, M. (2015). Spatial distribution of Dubas bug *Ommatissus lybicus* (Homoptera: Tropiduchidae) in date palm Frond Rows. Int. J. Entomol. Res., 03(01): 09 – 13.

Khalaf, M.Z. and Alrubaei, H.F. (2016). Impact of date palm borer species in Iraqi agroecosystem. Emirates Journal of Food and Agriculture, 28(1): 52-57.

Khalaf, M.Z. and Al-Taweel, A.A. (2015). Palm Borers in Iraqi Environment: Species-Damages- Methods of Control. J. of The Blessed Tree, 07(01): 54-64.

Khalaf, M.Z.; Al-Juboori, I.; Tareq, A.M. and Salman, A.H. (2019). Effect of the Mexican Black Scale, *Saissetia miranda* in the Iraqi Agroecosystem (Hemiptera: Coccoidea: Coccidae). Under publishing

Khalaf, M.Z.; Aljuboori, I.; Tareq, A.M.; Neher, F.H.; Salman, A.H. and Abdulhamza, A.B. (2019). Some aspects of Banded Conical Snail *Cochlicella barbara* (Linnaeus, 1758) [Gastropoda: Cochlicellidae]. Under publishing.

Khalaf, M.Z.; Al-Rubeae, H.F.; Al-Taweel, A.A. and Naher, F.H. (2013). First record of Arabian Rhinoceros Bettle, *Oryctes agamemnon arabicus* Fairmaire on date palm trees in Iraq. J. Agriculture & Biology Journal of North America, 4(3): 349-351.

Khalaf, M.Z.; Shbar, A.K.; Naher, F.H.; Jabo, N.F.; Abdulhamza, B.H. and Sami, R.A. (2012). Activity of insect fauna during the night in palm orchards of central Iraq. Journal of Food Science and Engineering/USA 2(2012): 277-282

Petty, G.W. (2004). Carbon dioxide in Earth's atmosphere. Sundog publishing, 229-251.

Rosenzweig, C. and Lglesias, A. (2001). Climate change and extreme weather events: Implications for food production, plant disease and pests." Global change. Human Health, 2(2): 90-104.

Samways, M.J.; Osborn, R.; Hastings, H. and Hattiagh, V. (1999). Global climate change and accuracy of predication of species geographical range: establishment success of introduced ladybirds (*Coccinellidae*: *Chilocours* spp.) world J. of Biogeography, 26: 795-812.

Sharma, H.C. (2012). Global warming and climate change: Impact on Arthropod Biodiversity pest management and food security. ICRISAT, 66-88.