



REVIEWARTICLE



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Biological Constraints in the Establishment and Development of Date Palm Orchards in Iraq(Review article)

Noor Taha Abd¹

Ahmed Fawzi Shafeeq¹

Nawras A.S. Al-Obeidi¹

Mustafa M. Fahad¹

¹Center of Desert Studies, University of Anbar, Ramadi 31001, IRAQ.

*Corresponding Author: mustafa.moh@uoanbar.edu.iq.

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ABSTRACT

Palm trees are the most important economic resource for Iraq in the past, which occupied advanced positions in the world in the number of palm trees and date production. However, palm groves have suffered a significant decline in their numbers for many reasons, such as climate change, drought, urban sprawl, neglect, geopolitical events, wars, and pests that affect palm groves. Studies have proven that biological determinants, which include disease and insect infestation, were among the oldest and most influential factors in the spread of palm groves and the decline in their numbers, which were approximately 30 million palm trees and declined to nearly half in the first quarter of this century. The article discussed the most important and most lethal pests in palm orchards, such as Khiyas palm pollen disease, shoot death, frond spotting, rot of the growing top, dobas, myxa, dust mites, and red palm weevil. These pests can lead to the destruction of large numbers of date palms, with infection rates ranging between 30 and 100% when appropriate conditions are provided. Because of its spread. It is concluded that insect pests are the most important biological factors affecting the spread of palm groves, and they cannot be eliminated and the deterioration of palm groves prevented except by developing an integrated control program under the auspices of the relevant state institutions.

Keywords: Date production, urban expansion, palm pests, biotic factors.

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INTRODUCTION

The palm tree has great and distinct importance in the Arab world, and it has a special status and symbolism among the Arabs because it is mentioned in many divine books and religious hadiths, which urge honouring the palm tree and give it descriptions that distinguish it from other plants. Palm tree is characterized by its tolerance to drought, so its cultivation is good in dry and semi-arid areas. It also tolerates neglect to some extent [1]. The palm tree has many uses, as it is the main source of food, agriculture, and exports, in addition to its role in reducing unemployment, since it requires many employees for agriculture. In the field of services, industry and trade, moreover, palm waste can be used as animal feed as well as for other economic aspects [2]. It plays a very important environmental and agricultural role in supporting the cultivation of citrus trees, especially in arid and semi-arid areas, such as Iraq and parts of the Arab world.

Palm cultivation and date production are among the most important and oldest agricultural activities in Mesopotamia (Iraq), which is believed to be its original homeland and which occupied the forefront in the number of cultivated palm trees, as the first documented appearance of the palm tree in the ancient world was recorded in the historic city of Eridu in southern Iraq before Approximately 4000 years BC [3], and the palm tree was even mentioned in seven laws in the Code of Hammurabi before 1754 years BC, which include penalties against those who cut down the palm tree, those who neglect it or take care of it, and other matters related to palm pollination and regulating the relationship between the tenant of the palm grove and its owner [4] [5] pointed out that Iraq's exports of dates suffered from severe fluctuation during the period between 1980 and 2008. After reaching 186 thousand tons in 1980, it decreased to 35 thousand tons in 1985, then rose to 145 thousand tons in 1990 and decreased again in 1995, with a production of 30 thousand tons, and decreased to its lowest.

production (8 thousand tons) in 2003, and then gradually increased to reach 33 thousand tons in 2008. Estimates also indicated that the number of palm trees in Iraq reached 32 million palm trees out of the total number of palm trees (96 million palm trees) were planted in the world during the era of the 1950s and 1960s, which contributed greatly to the prosperity of the Iraqi economy, in the seventies, Iraq reached the top of the world's countries in the global date trade [6], but these numbers decreased significantly by more than 53% in 2014 [7]. The number of registered palm trees in Iraq reached 17,348,741 palm trees, approximately 508,000 of which are male, and approximately 11,242,749 of them produced [8]. Iraq's production declined to occupy fourth place in the world [9], and then returned. The number of palm trees decreased again until it reached 15 million palm trees in 2018 [10]. In Basra Governorate in southern Iraq, which is characterized as one of the governorates that most cultivates palm trees, a study for the period from 1958 to 2021 recorded a decline in the number of palm trees in a

negative direction at a rate of -13.2% [11]. Perhaps the most important reasons for this decline are the successive wars that Iraq has experienced and the urban expansion that led to the razing of large areas of palm groves, as well as the high activity of epidemics and diseases, the impact of which was exacerbated by the lack of attention and care for palm trees. Environmental factors are among the most important factors influencing the spread of palm diseases and insects, which cause delay in the maturity of fruits, reduce their size and sugar content, and weaken the palm's resistance to insect and disease infections, which may cause its death. However, many insect pests and diseases target date palm trees; the severity of damage varies according to the variety, region, and prevailing climatic conditions, and pests affect different parts of the tree, some of which target the fruits or fronds and some of which target the main trunk [12]. All of these factors led to the spatial and temporal change in land use areas for palm cultivation [13]. Given the many factors that affect the spread of palm orchards, the most important of which are biotic factors, this study came to shed light in more detail on the direct impact of biotic factors on the life of the palm tree and its spread in Iraq.

Reasons for the deterioration of date production in Iraq

Most research [14] [10] [15] has indicated that the reason for the low productivity of dates in Iraq and the decline in their numbers is due to the following reasons:

- 1- Palm orchards have been subjected to severe neglect due to the high cost of service operations, especially since the palm tree needs experienced specialists to deal with it, such as those who are professionals in planting palm trees, removing dead fronds, diagnosing diseases, and having knowledge and experience in the process of manual pollination and pruning the stems.
- 2- The continuing urban encroachment on green spaces, especially palm groves, began to disappear after real estate prices rose steadily without government intervention to prevent such actions that affect the future of palm cultivation in the country. While studies indicate that Iraq needs to plant one million palm trees annually.
- 3- Climate changes and the decline in the levels of the Tigris and Euphrates rivers, which contributed to the decline in the number of palm trees and provided environmental conditions suitable for the spread of agricultural pests and their spread in palm groves. Even the timing of the appearance of some pests has clearly changed.
- 4- The lack of annual control of pests that affect palm trees and the scarcity of control campaigns conducted by the state using aircraft to eliminate pests that affect palm groves.
- 5- Sandy wind, which causes fruit dropping and decreases its quality
- 6- Late rains, which cause physiological disorders

Palm-growing areas in Iraq

Palm cultivation is widespread in Iraq at a latitude of 35 degrees north in the area extending between Mandali and Tikrit to the city of Al-Faw at a latitude of 30 degrees south, to include 13 Iraqi governorates extending from the governorates of Salah al-Din and Diyala in the north to Basra governorate in the south, but 7 governorates include the most important cultivation areas. Palm trees and date production (Table 1).

Table 1. The most important palm-growing areas in Iraq [16]

Regions	Governorate
Al-Deir, Shatt Al-Arab, Al-Haritha, Al-Madina, Al-Qurna, Abu Al-Khasib.	Basra
Nasiriyah, Souq Al-Shuyoukh, Al-Gharraf, Al-Chibaish.	Dhi Qar
Kut, Essaouira, Azizia, Badra.	Wasit
Karrada, Abu Ghraib, Yusufiyah, Kadhimiya, Adhamiya.	Baghdad
Baqubah, Mandali, Al-Khalis, Khanaqin.	Diyala
Hilla, Hindiyah, Alexandria.	Babylon
Heat, raw, pubic, grey.	Anbar
Fadak groves	Karbala

Abiotic factors

Agricultural diseases and pests are one of the problems facing agricultural production, especially in palm orchards in any geographical area, if environmental and climatic factors are present that help their emergence and spread. These pests lead to partial or complete damage to palm trees, or to a reduction in their nutritional value or lack of benefit, whether it is due to diseases, insects, or jungles.

The effect of diseases on the spread of palm orchards

The results of a questionnaire distributed to owners of palm orchards in Basra Governorate during the 2019-2020 agricultural season showed that 70% of their problems were caused by palm trees being infected with diseases and agricultural

pests spread in their lands [17]. The researcher attributed this to the availability of appropriate environmental conditions for these diseases, such as an increase in temperatures, humidity, and groundwater levels, which exacerbated the problem of the spread of these pests.

Fungal Diseases

Palm Pollen Disease (Khamedj Disease)

It is one of the most dangerous fungal diseases caused by the fungus *Mauginiella scaettae* Cav. This infects palm trees because farmers cannot diagnose it on the affected palms until after the palm pollen appears. This disease is often spread by transferring pollen from infected stallions to female palms during the pollination season, as it appears in the form of light brown spots at the top of the male and female palms. This leads to incomplete growth and drying out, and destroys a large proportion of the infected pollen. This disease has been recorded. An outbreak of khamedj disease in Iraq occurred in Basra Governorate in 1949, with an infection rate in palm trees reaching 80%, and the infection rate of this disease in Babylon Governorate reached 29% in 2007 [17]. This disease is widespread in many palm-growing regions worldwide, and production losses resulting from this disease in some countries may reach 5-40% [18] [19]. The incidence of this disease increases when appropriate environmental conditions are present, represented by low temperatures and humidity, which is why this disease appears greatly in the rainy winter. This disease is widely spread in Iraq in neglected orchards with little service, and the severity of the infection varies according to the varieties, as the Sayer, Khadrawi, and Brim varieties are among the most sensitive to this disease. In contrast, the most resistant varieties to this disease are Al-Zahdi, Al-Barhi, Halawi and others.



Figure 1: palm pollen disease (*Mauginiella scaettae* Cav.)

Date Palm Offshoot Death

This disease is caused by the fungus *Chalaropsis radiculicola* (Bliss) C. Morean; this disease leads to the death of a large number of palm seedlings, which may sometimes reach more than 70%. The spores of *Chalaropsis radiculicola* (causal agent of offshoot death) are typically single-celled and oval, while spores of *Thielaviopsis paradoxa* (causal agent of top rot) appear in chains. This morphological distinction is important for accurate diagnosis and classification [20]. The infection appears very early in the life of the seedlings (at 1-2 years old), as the disease leads to the cessation of seedling growth. Yellowing of the fronds and the appearance of brown or black spots of different sizes and shapes, and the most important reason for the increase in the incidence of this disease is the high salinity of the soil and irrigation water. Therefore, the highest infection rates are recorded in fields with high levels of salinity [21]. Recent studies indicated infection rates exceeding 70% in saline-affected areas in southern Iraq. The primary transmission occurs through contaminated irrigation water and improper agricultural practices [21]. Therefore, this disease may constitute a limiting factor for the spread and cultivation of palm groves, especially in the central and southern governorates of Iraq, which mainly suffer from high levels of salinity in their soil and irrigation water, which have begun to increase with the decline in the levels of the Tigris and Euphrates rivers, the rise in groundwater levels, and the neglect or burial of drains.



Figure 2. Symptoms of shoot death disease [*Chalaropsis radiculicola*(Bliss) C.Morean]

Leaf Blight and Spot Disease

This disease is caused by several types of fungi, the most important of which are: *Bipolaris australiensis*, *Thielaviopsis paradoxa*, *Alternaria alternata*, *Pestalotia palmarum*, and *Diplodia phoenicum*. This disease causes many palm fronds to wither, and the severity of infection with this disease increases with the increase in the age of the palm tree and the availability of environmental conditions for the spread of this disease, the most important of which is high humidity. Therefore, local studies have indicated that the infection rate with this disease ranged between 32.6 and 37.2%. The areas with the highest recorded incidence of this disease are the governorates of southern Iraq, especially Basra Governorate [22] [17].

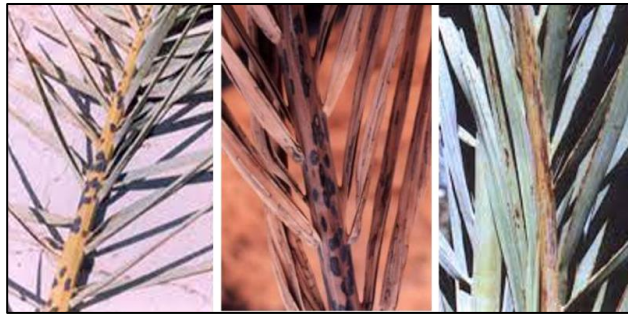


Figure 3. Symptoms of palm leaf spot disease (*Alternaria alternata*, *Pestalotia palmarum*,)

Crazy Top (*Thielaviopsis paradoxa*)

This disease is widespread in most palm-growing regions, such as Algeria, Morocco, Egypt, Mauritania, Kuwait, the Emirates, Saudi Arabia, the Sultanate of Oman, the United States of America, and others. At present, it has become an important palm disease in Iraq, especially in neglected orchards with poor drainage and high salinity. Recent studies have shown that the infection rate of the disease reaches 34.6% in some governorates, the most important of which is Basra Governorate, and this disease may lead to the death of infected palm trees within 6-24 months [23]. This disease is caused by fungi *Thielaviopsis paradoxa* (Dade) C. Morean, one of the most dangerous and widespread diseases due to the multiple transmission means and its parasitism on all types of palm trees. It also infects other families such as pineapple, sugarcane, tobacco, carrots, etc. It shows multiple symptoms, the most important of which is rotting of the growing top, which often leads to the death of the palm tree, or it may stimulate an axillary bud close to the growing apex, and a new head is formed. The disease appears in the form of rough black areas on both sides of the fronds, twisting, deformation and burning of the leaflets, which is known as black scorch. A third condition may appear on the affected fronds, and the flower buds may also become infected and appear. Symptoms are similar to those of palm pollen, and the infection may extend to the palm fruits, with black spots of various sizes appearing, especially in the Jamri and Khalal stages [20].



Figure 4. Crazy Top in palm trees (*Thielaviopsis paradoxa*(Dade) C.Morean)

Other diseases are less dangerous to palm groves and lead to economic losses, but they may not cause the extinction of palm groves, such as false smut diseases on palm trees.

INSECTS

Agricultural pests and diseases have a significant impact on the decline in the level of agricultural production. Among the most important pests recorded are the Hummera insect, the Dubas insect, the palm stem borer insect, the palm stem borer, the red scale insect, the dust spider, red palm weevil, and the palm pollen disease Khayas, as the loss in date production as a result of infection with these pests reaches more than 35% [14]. Although palm pests are known to those working in this field, their description and study of their importance in light of environmental variables and their impact on the life of palm trees are important matters that require further study. Through a field inventory of palm pests in the central and southern governorates of Iraq, the results of the autopsy of 126 palm trees (Table 2), which were taken randomly from these areas, the palm pests recorded there and their degree of importance are clear from the following table [24]. The number of insect and non-insect

pests that palm trees are exposed to reaches 132 species, 41% of which belong to Coleoptera. Palm borers are among the most important pests that affect palm trees in many countries of the world, including Arab countries, including Iraq [25] [26].

Table 2. Pests that attack palm trees and their economic importance in Iraq [24]

Name of pests	Scientific name	Order and Family	Priority level
Longhom date palm stem borer	Jebusea hammerschmidt Reich	Coleoptera, Cerambycidae	+++
Fruit stalk borer	Oryctes elegans Prell	Coleoptera, Scarabaeidae	++
Fronb borer	Phonapate frontalis Fahraeus	Coleoptera, Bostrichidae	+
Dubas bug (old world date bug)	Ommatissus lybicus Bergevin	Homoptera, Tropiduchidae	+++
Lesser date moth	Batrachedra amydraula Meyrick	Lepidoptera, Momphidae	++
Greater date moth	Arenipses sabella Hampson	Lepidoptera, Pyralidae	+
Termite	Microcerotermes diversus Silvestri	Isoptera, Termitidae	(+)*++
Parlatoria date Scale	Parlatoria blanchardii Targioni	Homoptera, Diaspidae	+
Gohbar mite(old world date mite)	Oligonychus afrasiaticus (McGregor)	Acari, Tropiduchidae	(+)*++

Lesser Date Moth

Batrachedra amydraula Meyer is also called the Hamira (local name) refers to a small insect identified scientifically as *Ommatissus lybicus* (Order: Hemiptera; Family: Tropiduchidae). The name "Hamira" comes from the reddish appearance of its nymphs, which cluster on the fronds and secrete honeydew (Figure 5). It has three overlapping generations per year, and the insect causes huge economic losses. The larvae of this insect feed on palm fruits of all stages (Hababouk, Jamri, Khalal, and Rutab), except for the date stage, which results in the fruits wilting and falling, when the infection is severe, it may lead to the fruit being stripped from the clusters, which in turn leads to a significant decrease in the yield, causing significant economic damage. [27]. The most serious infection with this disease was recorded in 1959 in Basra Governorate, which led to very large losses exceeding 80% of the palm yield, resulting in major economic losses [28]. The close proximity of the palm groves and the lack of adequate isolation led to the expansion of the infection with this insect. Therefore, if the insect is not controlled, it will be a limiting factor for the spread of palm cultivation in Iraq. In a study conducted by [10] to determine the impact of climate changes on the spread of Dobas and Hamira on palm trees in the governorates of the Middle Euphrates, the results of the study concluded that long-term climate changes in the values of climatic elements (temperatures and relative humidity), as well as their extremes, contributed to creating an ideal environment for the spread of the Dobas and Humira. The governorates most affected are the governorates of Diwaniyah, Najaf, and Karbala, while the least affected is the Muthanna governorate. Neglect of palm trees and the lack of integrated management to combat pests that afflict palm trees also contributed to their widespread spread, which led to a decrease in the number of palm trees in those areas.



Figure 5. Stages of the Lesser date moth [29]

Dubas date bug

The Dubas bug *Ommatissus lybicus* Bergevin (Figure 6), is among the most important pests that affect date palm trees, especially in Iraq [10]. What makes this insect more dangerous is its damage to Numerous palm trees, as the nymphs and adults of this insect feed on the plant sap of fronds, stems, and fruits. As a result, they secrete what is known as honeydew on parts of the palm tree, fruits, and even trees near them when the infestation becomes severe. It is a sweet-tasting liquid, which makes it a suitable medium for the growth of sooty mould fungi (Sooty mould) and others, and their accumulation leads to dust accumulation and a decrease in the vital activity of the wicker, thus reducing the vitality of the affected trees. They may be atrophied or small in size and covered with the honeydew, which causes dust to accumulate and is unfit for human consumption. The female Dubas insect makes cracks and grooves in the tissues of the wicker to lay their eggs in, which leads to damage to the plant tissue of the crack and the tissues surrounding it and may lead to the death of the wicker injury due to the Dubas insect for several consecutive years, some palm trees died [30]. Climate changes have greatly encouraged the spread of this insect in the regions of central and southern Iraq, to the point that the dates of its appearance have changed because of this. After the first appearance of the insect was recorded at the end of April, the insect now appears in February and may appear in an epidemic form at the beginning of the summer months [31].

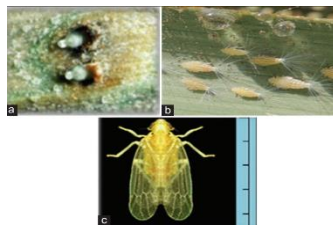


Figure 6. Phases of the Dubas bug. egg, Larvae, The whole insect [32]

Longhorn Date Palm Stem Borer

Excavators cause great damage to palm trees in the central and southern regions of Iraq, where infection rates reached 90-100% in the governorates of Basra, Karbala, and Babil. The most important, most widespread, and most harmful type of these excavators is the long-horned palm stem borer (*Jebusea hamerschmidtii* Reich) (syn. *Pseudophilus testaceus*), the genus of palm weevils (*Oryctes spp*), the Arabian rhinoceros beetle (*O. arabicus*) and Oamatthiesseni [33] (Figure 7). What increases the exposure damage to this insect is the pathogenic fungi and molds that this insect carries, which spread once the insect digs tunnels in the palm trunks. This insect is abundant at the tops of palm trees, the bases of young fronds, the buds, and the bases of the clusters. What distinguishes this insect is that it infects all types of palm trees. It makes holes in all levels of the palm tree at the bottom, middle and top of the palm tree. However, the holes made by these insects under the top are the most harmful and influential on date palm trees, as they lay a very large number of their eggs in them, and their larvae feed on the tender tissues in them. The infection rate in old palm trees may reach 90%. The infection may develop and subsequently lead to the death of the palm tree [34] [35], (Figure 7). What increases the harm of exposure to this insect is the pathogenic fungi and molds it carries that spread as soon as the insect digs tunnels in the trunks of palm trees. This insect is abundant in the top of the palm tree, the bases of the young palm tree, the jamara, and the bases of the stems [36]. What distinguishes this insect is that it infects all types of palm trees, and it makes holes at all levels of the palm at the bottom, middle, and top of the palm tree. This type of injury may lead to the death of the palm tree [24].



Figure 7. Longhorn date palm stem Borer, the pictures at the top are of the manifestations of the infestation, while the bottom are of the adult, larval, and pupal stages of the insect [31].

Dust mite (*Oligonychus afrasiaticus*)

The palm tree is a suitable environment for many arthropods, such as spiders, mites, and others. The palm tree constitutes an ecosystem consisting of vital components suitable for the livelihood of many organisms [37], and 51 insects were recorded wintering in the date palm, the most important of which is the dust mite, this insect is considered *Oligonychus afrasiaticus* (Figure 8) is one of the dangerous pests whose larvae, nymphs, and even adult spiders attack palm fruits and suck their juice, rendering them inedible. They cover the fruits (in the anthracite and khalal stages) with fabric, which is covered with dust and blocks the sun's rays from them to a large extent. The infestation appears in the stages of setting and fruit formation. It increases greatly in seasons in which dust storms are severe [35], The infection appears during the fruit set and fruit formation

stages. It increases significantly during seasons with severe dust storms [35], which have increased significantly in recent years, especially in the central and southern regions of Iraq, as losses were recorded in neglected or untreated orchards reaching 60%, especially in Basra, Maysan and Dhi Qar [31, 35].

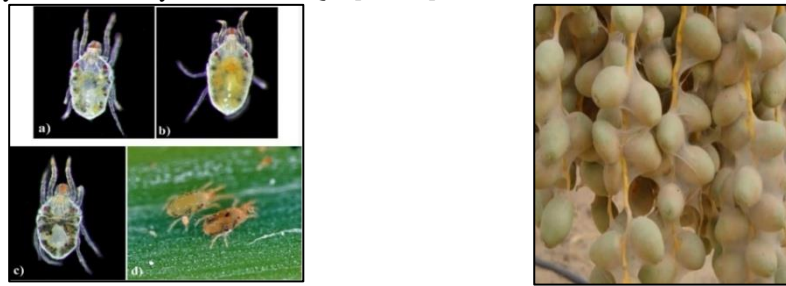


Figure 8. Phases of the Gohbar mite [29] and the appearance of the dusty web of mite on palm fruits.

Red Palm Weevil (*Rhynchophorus ferrugineus*):

The red palm weevil (Coleoptera: Curculionidae) is a highly invasive pest of palms that can have a significant economic, environmental and social impact when introduced into new geographical areas. It is the most important pest of date palm (*Phoenix dactylifera*) worldwide and a serious pest of coconut (*Cocos nucifera*). It is native to southern Asia. This invasive pest is considered one of the most dangerous threats to palm trees in Iraq. It was first reported in the southern provinces around 2015, where its presence has caused significant damage to date production. The Iraqi Ministry of Agriculture responded by launching large-scale monitoring, quarantine, and eradication campaigns.[38]

All life stages may be found inside the host palm. Each adult female deposits 200 to 300 eggs in separate holes or cavities on the host plant. Eggs hatch in two to five days, and larvae bore into the interior of the palms (Fig. 9), feeding on the soft succulent tissues. The larval period averages 55 days. Pupation occurs in a fibrous cocoon, and the adult weevils emerge 2-3 weeks after pupation. Thus, the life cycle is completed in about 4 months under optimal conditions in its native range. In most cases, an attack on Phoenix and other palms leads to the death of trees of a certain size (Fig. 9), whatever their [39] .



Figure 9. Phases of the red palm weevil [39] and its effect on the stems and leaves of the palm tree.

Conclusions

Insect pests remain the most important biological factors affecting the spread of palm orchards, in addition to other factors. The severity and type of infestation vary depending on the prevailing environmental conditions and the variables that may occur in a certain period. Political and economic factors can exacerbate the deterioration of palm groves and the spread of pests in them, and it is not possible to get rid of these pests and prevent the deterioration of palm groves except by developing an integrated control program sponsored by the relevant state institutions to get rid of them.

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المحددات الحيوية في انشاء وتطور بساتين نخيل التمر في العراق (مقالة مراجعة).

احمد فوزي شفيق¹

مصطفى محمد فهد¹

¹مركز دراسات الصحراء، جامعة الأنبار، الأنبار، العراق.

نور طه عبد¹

نورس عامر شاكر¹

الخلاصة

تعد أشجار النخيل من أهم المصادر الاقتصادية للعراق سابقاً إذ كانت تحتل مراكز متقدمة في العالم بعدد النخيل وإنتاج التمور، إلا أن تلك البساتين عانت من انحسار كبير في أعدادها لأسباب كثيرة كالتغير المناخي والجفاف والزحف العمراني والإهمال والاحداث الجيوسياسية والحروب والآفات التي تصيب بساتين النخيل. وقد اثبتت الدراسات ان المحددات الحيوية كالإصابة بالأمراض والحشرات كانت من بين أقدم وأكثر العوامل تأثيراً في انتشار بساتين النخيل وانحسار أعدادها التي كانت تقدر بحدود 30 مليون نخلة وانخفضت الى ما يقارب النصف في الربع الأول من هذا القرن. وقد تناولت المقالة أهم تلك الآفات وأكثرها فتكاً في بساتين النخيل كمرض خباس طلع النخيل وموت الفسائل وتبقع السعف وتعفن القمة النامية والدوباس والحميرة وحلم الغبار، يمكن لهذه الآفات ان تؤدي الى هلاك أعداد كبيرة من نخيل التمر إذ تتراوح نسب الإصابة بها بين 30 و100% عند توفر الظروف المناسبة لانتشارها. لذا يقتضي الأمر تدخل عاجل من قبل الدولة وتفعيل برامج مكافحة متكاملة والشاملة لجميع البساتين للسيطرة على تلك الآفات بأكثر قدر ممكن وزيادة وعي المزارعين بأخطار تلك الأمراض وتوفير المستلزمات الضرورية والنشرات الإرشادية للتخلص من تلك الآفات.

الكلمات المفتاحية: إنتاج التمور، التوسع العمراني، آفات النخيل، العوامل الحيوية.