

## The seasonal fluctuations in weather and their impact on the flowering, fruit setting, and growth of date palm fruits (*Phoenix dactylifera* L.) in Iraq

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### Abstract

Date palm cultivation is widespread in central and southern Iraq, along the banks of the Tigris and Euphrates rivers and their branches, as well as on the shores of the Shatt al-Arab. It extends along a latitude line of approximately 35 degrees north to 30 degrees south. The date palm has been closely associated with Iraq's ancient civilization and history, helping many communities to settle. Iraq preserves more than 630 varieties of agricultural varieties that are distributed geographically across date palm plantations. Date palm cultivation is confined to the latitude lines of 10 to 35 degrees north of the equator, but the date palm gives a good yield in areas where the temperature is high, the humidity is low, and rainfall is absent, from the flowering stage to fruit maturity. Temperature, humidity, light, and wind all affect growth, flowering, and fruit quality and maturity, in addition to limiting the spread of diseases and insects. These factors are determinants of the spread and success of date palm cultivation.

### Introduction

Climate is the average of long-term weather conditions that prevail in a particular region, and it is one of the basic determinants of the success or failure of date palm cultivation and production. It is also directly related to the quality and type of various date palm fruit varieties. Therefore, starting date palm cultivation, the prevailing climatic factors in the region must be taken into account and the suitability of the varieties to be planted studied [1].

Temperature is one of the most important factors affecting the economic yield of date palm production, as it has a negative or positive effect on the timing of flowering and fruit ripening, in addition to its direct impact on the quality and type of the produced dates. The temperature range of 32-38°C is suitable for the growth of this tree, and it can tolerate higher temperatures up to 50°C. In extremely hot regions, date palms give good yields, but the fruit is often dry and hard due to dryness and high temperatures. The fruitful date palm resists low temperatures between -6 and -12 °C for a short time, although most of the fronds may die. In Baghdad, all palm

fronds, whose age ranged between 4-6 years, died in Al-Zafaraniya farm when exposed to  $-7^{\circ}\text{C}$ , but it returned. It grew again in the summer, and it was observed in California that the date palm that was exposed to a temperature of  $-11^{\circ}\text{C}$  died, all its fronds died, but the growing top remained alive and gave growths of new clusters, and the trees bore pollen, but the growing pollen gave only few fruits. [2].

Alnajjar mentioned that date palm trees have anatomical and morphological responses to the vegetative parts and chemical responses in pollen due to environmental factors [3]. Based on the above, we can divide palm varieties according to the average temperature into [4].

1. Varieties that need an average temperature of  $21^{\circ}\text{C}$ , which are early ripening varieties.
2. Varieties that need an average temperature of  $24^{\circ}\text{C}$ , which are medium-ripening varieties.
3. Varieties that need an average temperature of  $27^{\circ}\text{C}$ , which are late ripening varieties.

also noted that areas suitable for date palm cultivation may not be suitable for it in the future due to climate change and fluctuations in climate factors, and that extreme cold and drought will be the determining factors in the distribution of date palm trees [5].

### **The effect of total thermal units:**

Thermal unit: It is the sum of the temperatures that exceed a certain limit for the growing season between nodes and maturity. The wet varieties need 2100 thermal units, while the dry and late varieties need 3600-4700 thermal units. Palm trees only thrive in areas where the temperature in the shade reaches  $18^{\circ}\text{C}$ . This is known as the degree of initiation of flowers and bears fruit in areas where the temperature in the shade is  $25^{\circ}\text{C}$ . From the beginning of flowering to the ripening of fruits, trees need temperatures ranging between 2337-3898 units. Thermal units according to the category and are calculated as follows:

Calculating the average daily temperature  $-18^{\circ}\text{C}$  during the period from the first day of May until the last day in October, i.e. considering the fruiting season as 184 days.

Calculate the average monthly temperature  $-18^{\circ}\text{C}$ .

(Maximum daily temperature + minimum daily temperature / 2) - 18

Or we can apply the following equation to get the heat needs:

Total thermal units = average monthly temperatures - 18 x number of days in the month.

Average temperatures were recorded from May 1 to October 31 in one of the date palm cultivation areas. Calculate the thermal units:

Month	The number of days in the month	The average monthly temperature Exceeding $18^{\circ}\text{C}$	Total monthly thermal units
May	31	2	$31 \times 2 = 61$
June	30	7	$30 \times 7 = 210$
July	31	9	$31 \times 9 = 279$
August	31	11	$31 \times 11 = 341$
September	30	6	$30 \times 6 = 180$
October	31	2	$31 \times 2 = 61$
		Total	$1134^{\circ}\text{C}$ [6].

## **Humidity**

Humidity is one of the factors determining the production of good fruit of date palm. During the pollination period and times of fruit ripening, the humidity and the rate of rain should be low, because this rain causes damage of the date palm fruits, especially if it falls early. Therefore, this reference study was developed with the aim of collecting and extracting some ideas from previous studies in order to find out some of the environmental and climatic needs of date palms in order to identify problems and find solutions to them [7].

When the spathe of the date palm matures, its cover splits longitudinally and reveals the spikes carrying the flowers. The female spathe contains 25-100 spikes, ranging in length from 20-100 cm and bearing between 8,000-10,000 flowers. The female spikes are long and curved, with yellowish flowers that are odorless. The male spikes, on the other hand, are shorter, about 12-24 cm in length, and are dense with white flowers that carry the distinctive scented pollen [8].

## **Flowering**

Flowering occurs on female trees in a manner similar to what happens on stallions, where pollens come out from the armpits of newly formed fronds in two or three batches, and in most cases the beginning is from the upper fronds. The external shape of the female tallness differs from that of the stallion, as the first is longer and thinner. As for the stallion, it is shorter and thicker. Both shoots crack in a similar manner from one of the two sides at the stage of maturity of the male flowers or when the female flowers are ready for pollination. The stallion's sepals are shorter, more numerous, and covered with flowers. As for the female's sepals, they are dispersed, bearing their smaller flowers at the meanders. [9].

## **Pollen grain**

Known as a small germ in the process of germination or a partially developed male gametophyte, and the pollen grain (consisting of the nucleus and the outer wall) grows inside the pollen sac located within the flower's stamen. The male inflorescence contains a large number of pollen grains, estimated to be 2.225 billion grains per 1 gm of pollen.

- Its shape is oval or spherical, and its length ranges between 18-24 microns, its width ranges between 10-12 microns, and it has a deep polar groove that extends along the pollen grain. As in other types of the genus, it is in the form of single cells.
- The outer surface of the pollen grain is decorated with a regular or irregular network pattern, and the depth of the ornamentation varies from one male variety to another.
- The small size of the pollen grains makes it easier for them to be carried by the wind, with the number of pollen grains in one gram estimated to be 2.286 million grains [10].

## **Pollen grain Viability**

One of the important factors for the success of the pollination process is the viability of the pollen grains. Pollen grains can maintain their viability when they are dry for a period of 2-3

months, and they can be stored at room temperature for one season, or in the refrigerator at 4 degrees Celsius for two seasons. They can also be stored for a long time at a temperature of -18 degrees Celsius.

Points to be considered when using automatic pollination of date palms

-Number of pollination times during the season: Determine the number of pollination times on the cultivar and the length of the validity period of the stigmas to receive pollen grains in addition to the length of the flowering season and the prevailing weather factors such as wind, rain and temperature. manual.

-Pollen concentration: Research has indicated that there are no differences in the percentage of fruit setting and the amount of yield when using different characteristics of pollen grains from 5 - 50%, the recommended concentration should be.

-Filling material: It is the material with which pollen grains are mixed at a concentration of 10%, so that the following conditions must be met in this filler.  
availability in the markets.

Dry and contain the lowest percentage of moisture. It has a specific weight close to the specific weight of pollen grains. Not deposited in the tubes of pollinators. Not to affect the female flowers. Not to affect the vitality of pollen [6].

Among the most important fillers that are used for mixing with pollen are fine flour, soft wheat bran, sawdust, and the remnants of male flowers.

After the pollen is extracted, the pollen is used with the filler in a ratio of 1 of the pollen grains to 9 of the flour.

A drop of the stain is taken and placed on a glass slide and a small amount of pollen powder is sprinkled over it. The slide is covered with a special cover and left for two minutes on a hotplate. It is then examined under a microscope to calculate the viability by counting the pollen grains that have turned red and those that remain white. The viability of pollen grains is important for the success of the pollination process, but its main impact is on increasing the fruit set and, therefore, the yield of the crop. It also affects the fruiting characteristics, particularly the ripening time. The characteristics of pollen grains have been studied in four Iraqi male varieties, specifically their viability, length, and diameter of pollen grain [11], as shown table 1.

**Table 1.** Characteristics of pollen in four varieties of Iraqi male palm [12].

Variety	Normal pollen %	Abnormal pollen %	Pollen viability %	Dead pollen %	Average pollen length $\mu\text{m}$	Average pollen diameter $\mu\text{m}$
Red Ghanami	84.2	15.8	95.3	4.7	26.6	16.6
Green Ghanami	95.0	5.0	99.0	1.0	28.3	18.3
Khukry Simsimi	92.0	8.0	84.9	15.1	31.6	16.6

Khukry Kritli	91.2	8.9	83.9	16.1	23.3	14.1
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### **The number of males needed for pollination**

On average, we need 5 male spikelets to pollinate a female pollinator, and the average of what a male palm rachis carries is 10-20 spikelet. If we take the minimum number of spikelet as 10, and each spikelet carries an average of about 180 inflorescences, then the number of female spikelet that a male palm can fertilize equals  $10 \times 180 / 5 = 360$  female palms, and if it is known that the average yield of a female palm tree is 10 spikelet, then one male date palm is sufficient to pollinate 36 female palm trees ( $360/10$ ), however, it is customary to allocate one stallion for every 25 female palm trees to ensure the availability of pollen needed to pollinate the palm tree [6].

### **Duration of reception of pollen by female flowers**

It is preferable to pollinate female flowers after they appear from the plant within 2-4 days, but there are some varieties, and in special circumstances, they may receive pollen for a longer period.

Some studies have indicated that the stigmas of female flowers of date palms remain ready to receive pollen grains for different periods that may reach 10 days or more, and in rare cases it may exceed 30 days, while the results of other research indicate that the stigmas of female flowers of date palms remain ready to receive pollen for a period of time ranging from Between 15-18 days, and in another opinion, the female flowers of the date palm remain pollen able and good fertilization takes place for 4 days from the beginning of the splitting of the stems. But the best and best vaccination is done within the first 48 hours from the beginning of cleavage, however, other researchers point out that the period of fertilization and the ability to fertilize extends until the end of the first week of cleavage, and sometimes up to 10 days. [13].

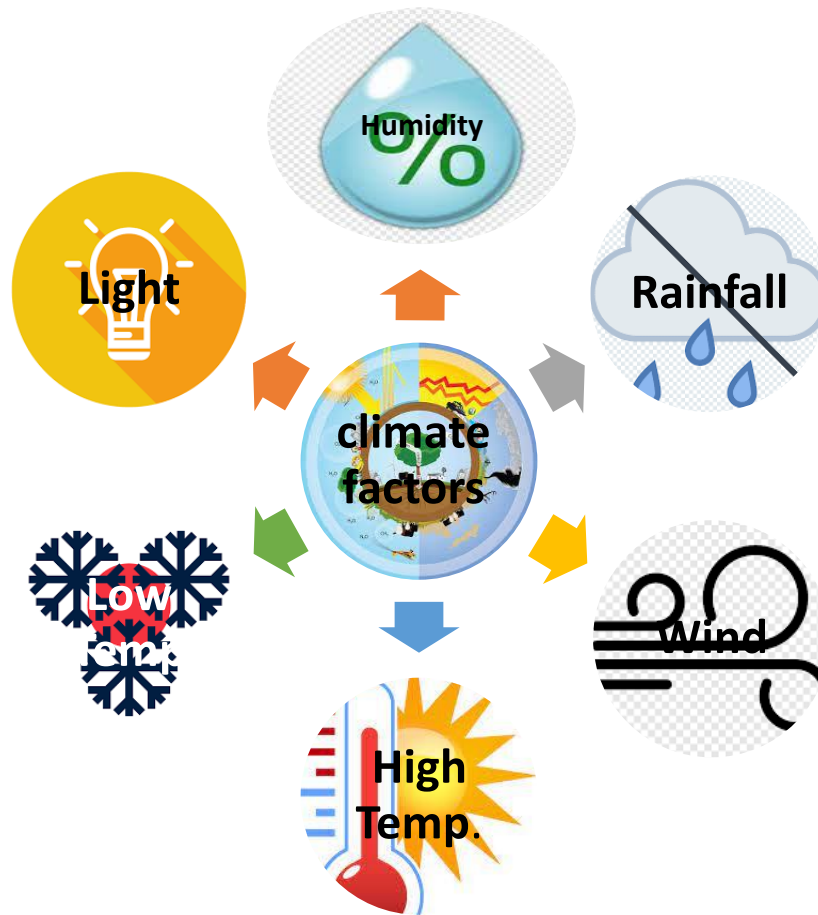
### **The pollen reception period depends on the cultivar:**

Sensitive varieties that need pollination within one day or less, including Al-Maktoum and Al-Ashrasi.

Other varieties: Al-Zahdi. It is possible to pollinate the palm tree for a period of 10 days, Al-Khastawi for 20 days, and Al-Barban and Al-Khadhrawi within 30 days.

### **Effect of some climate factors on the growth and fruiting of date palm trees**

Environmental factors have clear effects on the growth and production of fruits in date palm, and the interaction of environmental factors with genetic factors results in the phenotypic and physiological expression of the date palm, including the characteristics of growth and flowering, and then the formation of fruits. Climate factors can be summarized in Figure 1.



**Figure 1:** Some climate factors affecting the growth and flowering of date palm.

### **Humidity and rain and their effect on flowering**

The fall of heavy rain immediately after the pollination process leads to the removal of pollen grains from the stigmas of female flowers, and thus fertilization does not take place and the yield decreases. However, it was found that the pollen grains that reached the stigmas of flowers begin to germinate and grow rapidly if this rain did not fall for several hours after the pollination process. It has been proven that rain does not affect the pollen after 6 hours of the pollination process, but if it occurs before this, it reduces the contract. [14].

### **Humidity**

Humidity is one of the determining factors for the production of good dates. During the pollination period and times of fruit ripening, the humidity and the rate of rain should be low, because this rain causes damage to palm fruits, especially if it falls early. Some diseases that may cause the destruction of the crop, especially for late-maturing varieties. Moisture damage can also be identified as follows:

cracking: It cracks the fruits as a result of high humidity, but we notice that these cracks heal again and longitudinal streaks of earthy color come out, and sometimes this crack causes the pulp to dry out.

Splitting: it means the same principle, but the cracks remain open, so we notice the fermentation and damage of the fruits, and this happens when rain falls during the khalal stage.

Fruit spots: It occurs due to fungal infection that is encouraged by high humidity, where we notice brown spots and rotting of the base of the fruit at the area of contact with the funnel, and this occurs at the end of the khalal stage.

Fermentation: This occurs in the wet and tamar stages, where sugars are converted into alcohol and acetic acid, especially in the wet varieties.

Black of fruit: blackening of the tail or the tip of the fruit. It occurs at the transition from the ember stage to the stage of disruption. It is an unsatisfactory physiological phenomenon caused by the high relative humidity in the air and the accumulation of dew in the early morning on the fruits. This defect can be reduced by ventilating the taste and avoiding cultivars sensitive to this. The phenomenon in wet areas such as Deglet Nour and Hayany. [15].

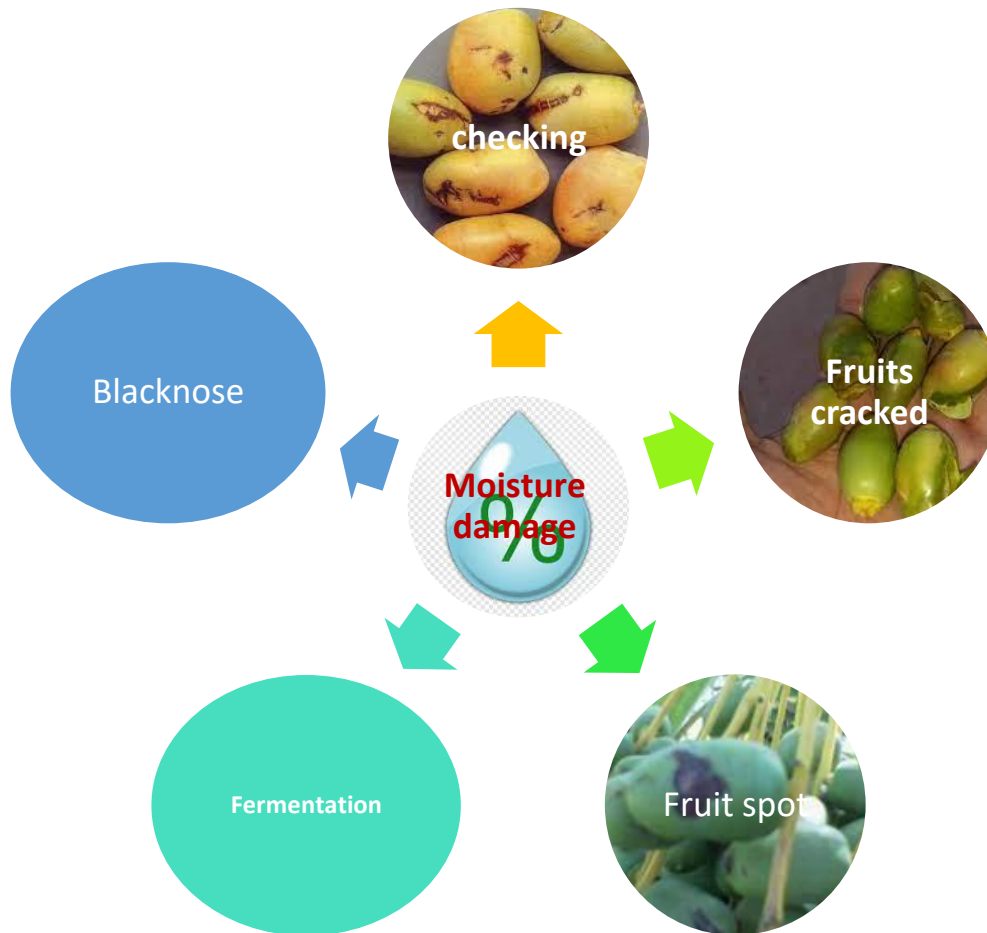
The date palm is one of the trees that grow in dry and semi-dry regions. However, humidity has a significant effect on the occurrence of insects and diseases in palm trees and dates. Relative humidity is usually higher in orchards than those do not have trees planted between the palm trees. High humidity in orchards encourages the occurrence of diseases such as inflorescence rot disease, failure of pollination, cracking of fruits, and infestation by the Dubas bug. This insect sucks the plant sap from the leaves and fruit stalks. Infestation is higher in orchards where palm trees are planted closely together and there are fruit trees planted between them [16]. High humidity coupled with a long rainy season during the months from November to March leads to a high incidence of inflorescence rot disease. This disease is widespread in southern regions like Basra and is particularly evident in palm trees planted in home gardens where humidity is somewhat high. Low humidity, on the other hand, facilitates the infestation of immature date fruits by dust mites such as the red spider mite during July, August, and September. These mites suck the plant sap from immature fruits such as Kimri and khalal [17].

The date palm tree requires a dry and clear atmosphere during the pollination period as well as during fruit ripening, as rainfall directly or within 10-12 hours after the pollination process washes away the pollen grains, leading to a decrease or failure in the pollination process. Therefore, it is recommended to carry out the pollination process when the weather is clear [18]. The date palm tree can tolerate dryness and a decrease in relative humidity up to 5%, as in desert regions. On the other hand, an increase in relative humidity in date palm cultivation areas can cause physiological differences such as fruit ripening, blackening of the tip, and fruit rot. Although date palms can grow in humid places, producing good fruit, requires less rainfall and a dry climate during the pollination and fruit ripening periods. During the pollination period, rainfall and high humidity help to spread the inflorescence rot disease or hinder the pollination process by washing away the pollen grains. In the wet and date fruit stages, the fruit may become infected with rot and fermentation in case of high relative humidity [19]. Although the date palm prefers dryness and high heat, a sufficient amount of moisture should always be present in the soil for the growth of the tree, flowers, and fruit development, especially at high temperatures. It is also possible to carry out some agricultural managements to reduce the negative effects of high humidity and rain, including:

- 1- Planting at appropriate distances.

- 2- Cultivation of early ripening varieties in areas where rain falls early.
- 3- Covering the stalks with paper or plastic covers to protect the fruits from rain.
- 4- Thinning the fruits by removing a number of spikes from the middle of the stalks for ventilation.

The damage of moisture can also be determined, as shown in Figure 2 [20].



**Figure 2:** Some moisture damage to date palm fruits

Moisture is considered one of the determining factors for producing good dates. During the pollination period and fruit ripening times, the humidity and rainfall rate should be low, as these rains can cause damage to date palm fruits, especially if they fall or shed early. Rain can hinder the pollination process and lead to inflorescence rot disease, as it helps spread some diseases that may cause the loss of the crop, especially late-maturing varieties [21].

### Temperature

Palm trees flower when the shade temperature is around 18°C and fruit set occurs when the temperature is around 25-50°C. Thermal units are calculated for date palm flowers and fruit ripening by taking the daily average temperature minus 18°C, and adding the difference in degrees each day to obtain the total thermal units required for a particular variety of date to mature on the tree. In March in the southern regions, the temperature is above 18°C, so date palms begin to flower and are pollinated during the second week of March until the second week

of April. In the central regions, the average temperature reaches 18°C in April, so date palms begin to flower and are pollinated during the first half of April until the end of the month. It takes around 3898 Thermal heat units for dates to mature from the time of flowering to ripening in these regions. High temperatures do not harm the date palms or their fruit during the ripening stages, but several days of temperatures below freezing can cause significant damage to the vegetative parts of the palm tree, such as the fronds, and can cause the death of many newly planted Palm offshoots [22].

The cultivation and growth of date palm trees are affected by the altitude above sea level. The cultivation is successful in areas with an altitude of 1000 meters, while it fails at elevations of 1500 meters above sea level, even if the area is close to the equator. Date palm cultivation on the southern side of the highlands is more successful than the northern side, due to its exposure to higher temperatures than the southern side. The date palm can withstand large fluctuations in temperature, withstanding maximum temperatures of up to 50 degrees Celsius and minimum temperatures of -2 degrees Celsius. The best areas for date palm production are those with an average maximum temperature ranging between 35-38 °C and a minimum temperature ranging between 4-13 °C [23].

Studies have shown that the temperature at which growth and cell division cease is known as the zero-degree temperature and ranges from 8.8 - 9 °C. The growth of the palm tree continues naturally throughout the year, proportional to the temperature rates, even in winter if the temperature is 9°C. Growth increases with an increase in temperature up to 38°C. The temperature at which flowers start to appear should not be less than 18°C, and the pollination should be at a temperature of 25°C. The temperature at the top growing point, also known as the meristem, is almost constant, but there is a difference between this and the surrounding air temperature. The daily temperature range at the meristem does not exceed 9.4°C, and it fluctuates inversely with the temperature of the surrounding air, being highest at sunrise and lowest around 2-4 pm. The difference between the internal temperature of the palm and the surrounding air temperature is around 14.4°C in the cold morning, decreasing to about 18°C lower than the air temperature at the end of the day. The relatively stable temperature at the growing point may be due to the thick insulating covering of leaf bases (Petiole) and surrounding fibers, which prevent the internal heat from leaking to the outside. The upward flow of sap from the roots to the apex meristem also affects its growth and keeps it close to the temperature of the water surrounding the roots [24]. The temperature can also cause drought during certain seasons.

### **Effect of total thermal units**

The fruitful date palm resists low temperatures between -6 and -12 °C for a short period, although most of the fronds may die. In Baghdad, all palm fronds, whose age ranged between 4-6 years, died in Al-Zafaraniya farm when exposed to -7 degrees Celsius, but they returned and grew again in the summer. It was observed in California that the date palm, which was exposed to a temperature of -11 °C, died of all its fronds, but the growing apex remained alive and gave growths of new fronds, and the trees bore spathe, but the growing pollen gave only few fruits.

When a freeze occurred for a period of 18 hours, it was noted that the offshoots, whose age ranged between 1-3 years and of all varieties, were severely damaged, and many of the one-year-old offshoots died, but the date palms, whose age ranged between 4-6 years, died 15% of their fronds, especially the cultivar [25]. Deglat Nour While the two varieties, Al-Zahdi and Al-Khastawi, had less damage than Al-Khadrawy and Al-Halawi, whose damage was more severe. As for the fruit trees, whose age ranged between 8-20 years, the percentage of damage was low. It was noted that the irrigated orchards during the freezing period had less damage than the non-irrigated ones. The varieties of palm trees were divided according to their resistance to cold into resistant varieties, which are Al-Zahdi, Al-Hayani, Al-Ashrasy, Al-Khastawi, Al-Sayer and Al-Thawri, and medium-tolerant varieties, namely Deglat Nour, Al-Barhi, Al-Diri, Al-Amiri, Al-Khadrawi, Al-Maktoum, and Al-Majahul, and cultivars sensitive to cold are Al-Brim, Al-Halawi, Al-Khalas, and Al-Farsi [26].

### Effect of high temperature

Date palm trees grow in all hot regions of the world except for extremely hot areas such as northern Sudan, where dates do not ripen in their usual form of softness and juiciness, but instead become dry and hard. The reason is due to the dryness of the weather, and palm trees bear temperatures of more than 50%, as in Iraq (Basra) [27], table 2.

Table 2. shows average temperatures from May 1 to October 31, 2022 in one of the date palm cultivation areas in Iraq [6].

Month	Number of days month <sup>-1</sup>	Mean monthly temp. °C	>18 °C start of flowering	Total monthly thermal degree units
May	31	20	2	31×2=61
June	30	25	7	30×7=210
July	31	27	9	31×9=279
August	31	29	11	31×11=341
September	30	24	6	30×6=180
October	31	20	2	31×2=61
Total				1134 °C

### Light

Light is considered one of the essential factors for plant life, as it plays a major role in building carbohydrates, which are the main component of dates, in addition to its role in the formation of many of the vital compounds for the date palm tree. The date palm is one of the helophytes species [28]. The palm tree cannot achieve good yields in areas where clouds and fog are abundant, even if the appropriate thermal requirements are available. In such areas, plants tend to persist in vegetative growth and increase their stems height in search of light, resulting in weak production. Therefore, planting palm trees at suitable distances that allow for full utilization of light which is one of the main factors in date palm cultivation and the production of a good yield with good specifications [29]. Blocking light leads to stunted growth of date palms in regions that are extremely hot because the process of producing the main nutrients stops in

these regions. Natural growth occurs during sunset and sunrise, although they may grow slowly during the day. Upon analyzing sunlight, we find that short rays (ultraviolet waves) hinder natural growth, while long waves (red and green) increase growth [30].

The energy of sunlight is moved as electromagnetic waves carried via small particles called photons, which called a quantum. The energy of these particles depends on the wavelength. The productivity capacity of the palm tree depends on converting the light energy into potential or stored energy in the form of carbohydrates (starch sugars) through the process of photosynthesis. This process takes place in the leaves of the date palm [31]. within two limits of the intensity of illumination, the first is the limit of compensation, and it reaches 200 lumens of light, and the leaves do not benefit from it, because what the leaves make of sugars in the process of photosynthesis is consumed by the process of respiration. The rate of photosynthesis increases until the leaves reach the maximum limit of converting light energy into carbohydrate materials, converting light energy into carbohydrates and photosynthetically, the light energy is expiated to converse carbon dioxide (CO<sub>2</sub>) and water into sugar. Oxygen is a waste product, which occurs at an illumination intensity of 5000 lumens, which is called saturation point. increase in photosynthesis may also include partial re-assimilation of the evolved photo-respiratory CO<sub>2</sub>, which is considered to maintain the carbon flux and the enzymatic substrate turnover, and enables the plants species that when light is saturating, the actual rates of CO<sub>2</sub> assimilation are limited by the amount, activity and kinetics of Rubisco more often than electron transport rates, a situation detected when  $C_i < C_{i\_inflection}$ . [32]. The intensity of the sunlight falling on date palm leaves reaches 12000 lumens in the midday summer, which is more than the palm tree needs. The production capacity of the palm tree depends on: [33].

- 1- Duration of compensation and saturation.
- 2- The length of the photoperiod, which is affected by the geographical location (latitude) and the time during the seasons of the year. The date palm needs a long daylight hour of up to 16 hours of light per day to obtain the highest production capacity.
- 3-The total green area of the leaves (fronds) exposed to sunlight.

- 1- The leaf distribution system in the top of palm tree (Phyllotaxy) is configured so that one leaf does not coincide with another until after 13 leaves have passed in the arrangement, and this reduces direct leaf shading to each other and gives more opportunity for completed leaves to benefit from the distribution of sunlight.
- 2- The relatively long life of the palm leaf (6 years) is considered a catalyst for raising production capacity to the maximum extent possible.

In general, the possibility of implementing sustainable agriculture by growing multiple crops utilizing of the semi shade caused by trees, especially for those crops with less requirements of light intensity.

### **Effect of light on photosynthesis**

The primary element in the process of carbon metabolism (photosynthesis) is light, where all the green parts of plants, including stems, leaves, and unripe fruits, contain chloroplasts that perform photosynthesis. However, green leaves are the primary or main sites for this process. There are half a million green chloroplasts in every 1 millimeter of a leaf, and the green color of leaves is a result of the presence of the green pigment chlorophyll in the green chloroplasts

mainly located in the mesophyll cells. Carbon dioxide and oxygen diffuse through the stomata, while water is absorbed through the roots and transported through the xylem. The phloem transports the products of photosynthesis to the parts of the plant that require them [34].

### **Winds**

Winds do not generally directly affect the success or failure of palm tree cultivation. However, cold or hot winds may cause some damage, and dust may affect the fruits during the Rutab stage and Tamer. In addition, if there is too much sand, it may cover the trees. In Basra, if the dry north winds continue in the summer, which pass over the Syrian desert until the fruits ripen, the Halawi date variety tends to be dry and the incidence of a locally named condition called "Abu Khushaim" increases. This condition causes the tip of the fruit near the perianth to dry out while the lower part remains moist. On the other hand, the moist east winds that pass over the waters of the Arabian Gulf before the dates ripen make the same variety soft [35]. It affects the success of the pollination and fertilization process. If the wind is moderate in its temperature, humidity, and speed, moderate to low, then it moisturizes the stigmas and thus increases the nodes. But if the temperature is high, dry and strong, then it removes pollen grains and may dry the stigmas, so the pollen grains do not grow, and therefore they do not knot and become less or non-existent. The yield may cause the destruction of the yield, especially for late-maturing cultivars.

The occurrence of dry northwesterly winds for several days during the transformation from Rutab to Tamer of the date is an important stage in determining the quality of the dates. The occurrence of dry winds may lead to the appearance of a physiological disease called "Abu Khushaim" in the southern region, especially in Basra. This condition is characterized by a light-colored ring near the perianth area of the Halawi dates, which tends to turn yellowish, and the flesh is firm compared to the rest of the same fruit. The external segments of the spathe contain 6-20% Abu Khushaim dates, while the internal spikes contain 1-6% Abu Khushaim dates [36].

The winds also play a significant role in the transfer of pollen during the flowering and pollination season. Pollen is carried by the winds due to its lightweight and high density, and this plays a significant role in reducing production costs. However, good production requires manual pollination, which results in a larger yield. In addition to the above, winds also play a major role in drying the moisture of fruits in humid and coastal areas, as well as in areas that are prone to rainfall during the fruit growth season [37].

### **Harmful effects of wind on palm trees:**

Pollination of the date palm occurs naturally by the action of wind. However, for marketable productivity, it is required to by-hand pollinate date palms [38]. Ordinarily, each grower distinguishes the DPP source and extraction technique that gives the best results. It is assist that one intact adult male palm is enough to pollinate up to fifty female palms[39]

- 1- Strong winds during the pollination period impede the completion of this process, as well as a decrease in the yield and a decrease in the quality of the resulting fruits.
- 2- Strong winds carrying sand particles cause many fruits to fall off. It also causes cracking of the fruit's skin and reduces its quality, especially in the Rutab stage.
- 3- Strong winds carrying sand may cause it to gather around palm trees in areas where sand dunes are widespread.

4- Sometimes strong winds may lead to the fall of trees, and this happens in weak old trees and those planted in shallow lands because their root system does not spread to great depths in the soil, or the trees may be infected with the stem borer that causes the trunk to weaken, or as a result of the weakness of the trunk of the palm due to the removal of large number of offshoots around the base of the tree.

The effects of air contaminants on pollen are discussed in relation to sexual reproduction, gametophyte selection and adaptation to stress. Pollen may be used as sensitive biological indicators of pollution. [32].

### **Epigenetic heterogeneity for environmental stress tolerance**

These are genes that encode when an organism is exposed to abiotic stresses such as heat, drought, and high light., which cause changes in the DNA sequence. These molecular processes can occur either by methylation of DNA and histone acetylation or by removal of a methyl group [34,35]. A dominant view of random mutation on the origin of phenotypic combinations with palm-angiosperms produced by tissue culture has been developed from the inability of hormone-dependent gene regulation processes. [40]. concluded that future efforts should focus on epigenetic regulation targeting MADS-box genes and transposable elements as they regulate phenotypic variation in palm flowers. Also, female flowers may be used to breed new date palm individuals using tissue culture technology [41]. Somaclonal variation occurs due to epigenetic genes [42]. Epigenetic mutations may control the natural variability of flower symmetry Epigenetic mechanisms also regulate sex in date palms [43]. by controlling flowering-inducing genes encoding. Therefore, this mechanism is very important in breeding date palm when it is produced by tissue culture and invested properly [44].

### **Pollen source effect**

Female date palms are characterized by the fact that they can be pollinated from any type of male palm. Palm farmers in many areas of palm cultivation have noticed since ancient times that the choice of the type of stallion has an impact on the fruits formed. Therefore, known stallions were chosen to be a source of pollen. The researchers concluded that there is a clear effect on the fruits, and this effect is divided into:

Xenia genetic effect: It is the genetic effect of the pollen grain, i.e. related to the genetic effect of the formation of the embryo and endosperm in the coming generations formed, which arise as a result of the convergence of the genetic structures of the pollen grain with the genetic structures of the ovary during the double fertilization process (where the endosperm contains  $3n$  of chromosomes, of which  $2n$  comes of the ovary and  $1n$  of the pollen grain, and these genotypes are important in breeding, improvement and crossbreeding).

Metaxenia non-genetic effect: the direct effect of pollen grains on the flesh and core of the fruits, where the pollen grains affect the size, shape, color, and ripening date of the fruits, and this characteristic we find important in Iraq. Nutrients and hormone-like substances that spread in the flesh of the fruit to affect positively or negatively, depending on the source of the pollen. [32].

### **Conclusion**

As a result, palm trees are able to withstand these abiotic stresses and adapt to a variety of environments. Palm trees respond to environmental factors and seasonal climate fluctuations through some morphological, physiological, and anatomical variations as well as some chemical pollen components, particularly proteins. Crop management, breeding, and molecular biology technologies can all be used to find and identify new palm varieties that are resilient to climate change. Additionally, there is a strong focus on implementing as many soil and crop management strategies as possible, as this will significantly contribute to reducing the use of growth inputs and increasing output and productivity. These controls must be founded on rational management choices. Using tissue culture technologies, epigenetic mechanisms can also be used in palm production to tolerate these variations. Due to the changing climate in the cultivated region, date palm output could be affected globally.

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## التقلبات الموسمية في الطقس وأثرها في أزهار وعقد ونمو ثمار نخيل التمر في العراق

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### الخلاصة:

تنتشر زراعة نخيل التمر في العراق في المنطقتين الوسطى والجنوبية وعلى ضفاف نهري دجلة والفرات وفروعهما وشط العرب وتمتد بخط عرض حوالي 35 درجة شمالاً حتى خط عرض 30 درجة جنوباً، ولقد ارتبطت نخلة التمر بشكل كبير بحضارة العراق وتاريخه القديم بحيث ساعدت الكثير من الاقوام على الاستيطان ويحتفظ العراق بأكثر من 600 صنف من الأصناف الزراعية المنتشرة في الرقعة الجغرافية المزروعة بالنخيل. تنحصر زراعة نخيل التمر بين خطي عرض 10 و 35° شمال خط الاستواء ولكن نخلة التمر تعطي حاصلًا جيدًا في المناطق التي يكون فيها الجو ابتداءً من الأزهار حتى النضج للثمار مرتفع الحرارة قليل الرطوبة خالي من الأمطار، وتؤثر كل من درجة الحرارة والرطوبة والإضاءة والرياح على النمو والتزهير وموعده وكذلك في نمو الثمار وصفاتها النوعية وموعد نضجها بالإضافة إلى الحد من انتشار الأمراض والحشرات وتعد هذه العوامل من محددات انتشار ونجاح زراعة نخيل التمر.

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### الكلمات المفتاحية:

نخيل التمر، درجة الحرارة، الرطوبة،  
الضوء، الرياح.

### معلومات المؤلف

الايمل:

الموبايل: