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Research Article

Climatic Requirements for Cultivating and Producing Two Grape Kinds in the Province of Babylon

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Abstract

The present study is one of the geographical studies that investigates the field of agricultural climate. The focus is on studying the Shadda Abyad and Buz Al-Anza or what is locally called Dis Al-Anz grape kinds in the study area.

Keywords

Grapes, thermal limits, varieties

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Introduction

Grapes are vine plants that takes a cluster shape. It consists of a main branch with several secondary branches. It is considered one of the fruits of Paradise immortalized in the Glorious Quran. It is mentioned in eleven ayahs, including the thirty-fourth ayah of (Al-Shammari, Abood, & Hamdi, 2020) (And we make therein gardens of palms and grapevines and we make springs to flow forth in it. In order to achieve the desired research objectives and reach tangible results, the following scientific research steps were followed:

The Problem of The Study

What is the degree of congruence between the climatic requirements for the cultivation and production of grapes in the study area in general and the climatic requirements in the model farm?

The Hypothesis of The Study

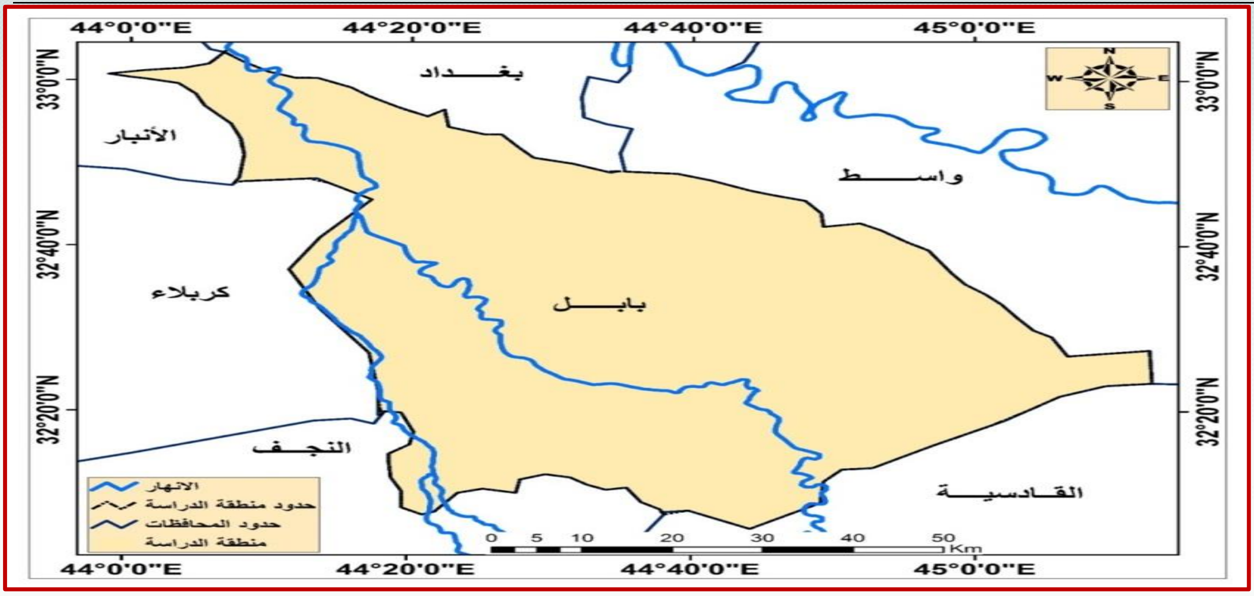
There is no complete agreement between the climatic requirements for the cultivation and production of grapes in the study area and the climatic requirements in the model farm.

The Objectives of The Study

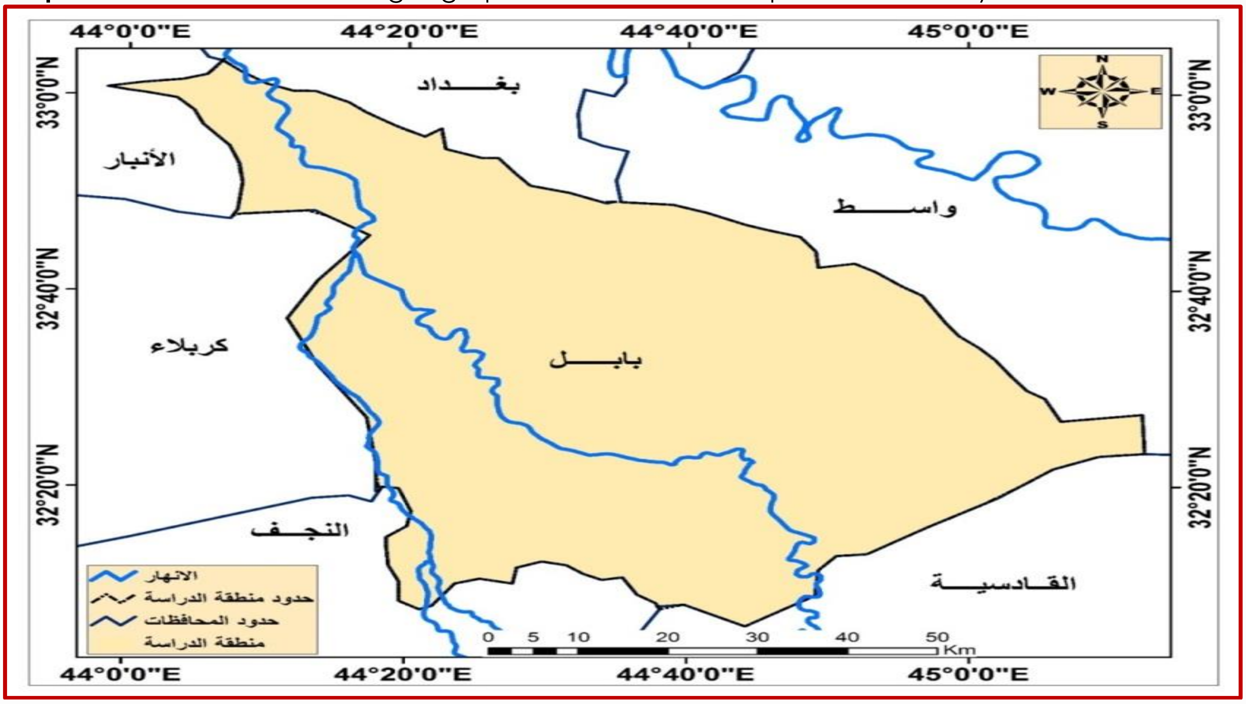
The present study aims to show the extent of compatibility between the requirements of cultivation and production of grapes in the province of Babylon and the climatic requirements in the model farm by comparing those requirements with what is reached through field studies and field measurements in the model farm to come up with tangible and applicable results that may serve as a road map guiding those who cultivate grapes.

The Location and Boundaries of The Study Area

A. The astronomical location: Babylon province that extends between two latitudes (18° 6°32) (30° 4° 33) north, and longitudes 24° 58° 43° (= 19° 12° 45) east.
B. Geographical location: The province of Babylon that is geographically located in the central region of Iraq within the sedimentary plain area with an area of (5306.74) km2, which constitutes (2.1) % of the total area of Iraq. Baghdad occupies the northern borders of Babylon, Najaf and Qadisiyah occupy the southern borders, Wassit occupies the eastern borders, and Karbala and Anbar occupy the western borders as in Map (1).



Map 1. The astronomical and geographical location of the province of Babylon



Source: Republic of Iraq, Ministry of Planning, The Information Systems Center.
Heat and humidity requirements for cultivating and producing grapes in Babylon

Temperatures

Temperatures play the main role in the success of the life cycle of the plant (Atkinson, Brennan, & Jones, 2013) because of the great effect on most of the physiological processes (Basannagari & Kala, 2013). In the different stages of its life, the plant requires a certain temperature range for germination. This range begins with the minimum temperature that represents the lowest temperature at which growth occurs. It ends with the highest temperature that represents the highest temperature it can withstand. It also has a temperature at which the best growth is achieved.

Minimum Temperature

It is the minimum temperature required by the plant in order to grow. It differs according to the type, varieties, and phases of the plant (Mahmood, 1997). The minimum biological beginning of the stages of bleeding or the flow of succulents is determined when the soil temperature rises (5 - 7) m. Growth stops at the temperature of zero growth (10) m in the Fall. This temperature is considered the biological zero for grapes (Bernard, Eaton, Jensen, & Kortum, 2003; Woodward & Woodward, 1987). It endures the budding phase at (10), rooting between (11-12), flowering between (12 - 15), setting fruits between (18 - 22), and fruits ripening is between (20-25) as in Table (1).

Table 1
Minimum temperature limits for grapes (C)

Growth phase	Minimum temperature
Budding	10
Rooting	11-12
Flowering	12-15
Setting fruits	18-22
Fruits ripening	20-25

According to the field measurements, budding limits reached (12-19), rooting limits reached (14-21), flowering limits reached (16-23), setting fruits limits reached (18-26), fruit growth limits reached (25-28), and fruit ripening limits reached (28-30) as in Table (2).

Table 2
Minimum, optimum and upper thermal limits for grapes

Growth phase	Minimum temperatures	Optimum temperatures	Maximum temperatures
Budding	12-19	18-25	24-30
Rooting	14-21	20-28	26-32
Flowering	16-23	22-31	28-38
Setting fruits	18-26	25-34	33-42
Fruits growth	25-28	33-37	41-45
Fruits ripening	28-30	36-39	44-48

Source; field study from March to June.

Optimum Temperature

It is the temperature at which the vital processes in the plant proceed as best as possible. Within those processes, the plant can obtain the highest level of growth, flowering, and fruiting. Those processes vary according to the type of plant, varieties, and phases (Hua, You-Xin, Li-Chun, & Hua-Bin, 2007; Souza, Andrade, Oguntunde, Arsić, & Silva, 2018; Subedi, 2019). Budding bears an optimum temperature between (12-14), rooting (15-20), flowering (17-25), setting fruits (20-25), and ripening (28-32) as in Table (3).

Table 3
The optimum thermal limits for grapes (C)

Growth phase	Optimum temperature
Budding	12-14
Rooting	15-20
Flowering	17-25
Setting fruits	20-25
Fruits ripening	28-32

Source: (Hussein, Alkaabi, Ghebreyesus, Liaqat, & Sharif, 2020)

According to field measurements, the optimum temperature of budding reached (18-25), rooting (20-28), Flowering (22-31), setting Fruits (25-34), Fruit growth (33-37), and fruit ripening (36-39) as in Table (2).

Maximum Temperature

It is the maximum temperature at which the plant performs its vital activities, especially growth. It varies according to the type of plant, its varieties, and its phases (Hua et al., 2007)(Al-Okaili, 2021). The maximum temperatures that grapes tolerate differ according to their varieties and stages of growth. They are between (25-30) in budding, (25-30) in flowering, (26-32) in setting fruits, and (35-38) in fruits ripening. However, if it rises to (40) C, it will lead to the dropping of flowers and fruits, and growth stops in (43) C. Fruits fall prematurely at (45) C. Consequently, significant damage occurs to all parts of the tree as shown in Table (4).

Table 4

The maximum thermal limits of grapes (C)

Growth phase	Maximum temperature
Budding	15-18
Rooting	20-30
Flowering	25-30
Setting fruits	26-32
Fruits ripening	35-38

Source: (Al-Shammari et al., 2020)

As for the field measurements, the maximum temperatures of budding reached (24-30), rooting (26-32), flowering (28-38), setting fruits (33-42), fruit growth (41-45), and fruits ripening (44-48) (Al-Wae'li, 2014) as shown in Table (2).

Clustered Temperature

It is defined as the number of accumulated temperatures during the growing season that exceed the minimum temperature for plant growth to reach ripening. The number of heat units accumulated during the grape growth season varies according to its varieties. The early ripening varieties need (1600) heat units to mature. The late-ripening varieties need (3500) heat units (Lalic et al., 2018)(Al-Shalash, 1984).

Through the field study, the two grape varieties referred to in the present study matured within a record period that did not exceed four months, which extended from the beginning of March until the end of June. The accumulation of temperatures during this period contributed to the acceleration of all the different stages of growth. Using Selenov's equation shows that the number of thermal units that accumulated during that period reached (2543) thermal units.

- x = combined temperature C
- b = temperature of the last day of the month C
- A = thermal threshold that is (10) C
- d = number of days with temperatures above the thermal threshold

496 + 615 + 682 + 750 = 2543 heat units.

Soil Temperature

Soil temperature of (28) C is the ideal temperature for grape treesThe temperature of the soil in the shade was measured at a depth of (15-20) cm, which is the depth at which the grape seedlings are planted. It was lower than the limits set in previous books and studies. According to field measurements, its temperature from the beginning of the growth of the crop until the stage of full ripening reached (15-27) C due to the shading caused by the trees and grape branches, which cast shadows on the farm floor. Thus, they contribute to blocking solar radiation, which is the main source of soil temperature.

Atmospheric Pressure and Wind

Atmospheric pressure has a great effect on the movement of wind and rain (Hussein et al., 2020). Light winds with suitable humidity and temperature is suitable for growing grapes. The light wind during the flowering period helps to transfer pollen and conduct the pollination process as well as activating the processes of photosynthesis and respiration (Mahmood, 1997). The wind speed of no more than (4) m/s is ideal for the growth of grape trees naturally (Oliver, 1978). In the field study, no significant damage was recorded inside the model farm, no matter how strong the wind speed due to the presence of grape branches that cover all the farm floor and limit wind speed, as well as the presence of windbreaks, which had a great effect on reducing the intensity of the wind and decreasing damaging the grape crop.

Relative Humidity

Relative humidity quantitatively and qualitatively affects precipitation as it affects the characteristics of the wind and the degree of its humidity and dryness. It directly affects plant growth through its effect on the amount of evaporation / transpiration. The higher its percentage in the atmosphere, the lower the rate of evaporation / transpiration in the plant (Pimentel et al., 1997). Its decrease that is accompanied by a rise in temperature causes an increase in the rate of water loss by evaporation / transpiration at a faster rate than the ability of the roots to absorb water, which may result in an imbalance in the water balance of trees and consequently their drying and falling of some parts (Qader, Atkinson, & Dash, 2015). The growth of grapes is normal when the relative humidity ranges between (50-80%). The levels of photosynthesis decrease when they reach (40%) and stop when they drop to less than (20%) (Selten, Branstator, Dijkstra, & Kliphuis, 2004).

In the field study, the situation differs in the study area due to the geographical and astronomical location and the necessities of a climatic environment that is characterized by hot and dry summer. The relative humidity inside the model farm decreased to much less than those limits. It did not affect the physiological processes of grapes at various stages of growth, but rather the opposite. It grew and produced naturally and achieved perfect ripening with full soft grains during a record period that did not exceed four months as shown in Table (5).

Table 5

Field observations of minimum and maximum relative humidity

Maximum humidity	Date of observation	Time of observation	Minimum humidity	Date of observation	Time of observation
27	5 am	15	10/6/2021	2 pm	
4930/6/2021 15/3/2021	7 am	42	1-5/2021		

Source: field study from March to June.

Conclusions

1. The field study concluded that the growing season of grapes extends for eight months, starting from March to October, but the time taken for ripening varies according to the different varieties. There are early, medium, and late varieties.

2. The field study showed that the date of ripening of the two grape varieties referred to in the study is in the month of June and not in the months of July and August as other sources state.

3. It was evident through the field study that the two types of grapes grew within thermal limits that did not harm the grape crop. According to the field study and field measurements, the minimum thermal limits for all stages of growth ranged between (12-30), the optimal limit is between (18 - 39), and the maximum limit is between (24 - 48).

4. The field study proved that the number of heat units accumulated during the growing season varied according to the different varieties. This was proven in the field study. The units of the early varieties were less than they are for the late varieties. Those heat units accumulated in a way that led to accelerating all the different stages of growth. Thus, the ripening time became early.

5. It appeared through the field study that the soil temperature was lower than the limits set in books and previous studies that determined its temperature at (28) C. Its temperature in the field study is between (15-27) C since the beginning of the budding phase in March until the end of the ripening phase in June.

6. The field study reported that the windbreaks had a significant effect on reducing the intensity of the wind that led to decreasing the damage of the grape crop. No significant damages were recorded inside the farm despite the fact that the wind speed increased above the optimum limits for growth according to the data of the stations of the study area and what was mentioned in the sources and previous studies.

7. The ideal limits of relative humidity range between (50-80%) according to previous sources and studies. According to the field study and field measurements, the minimum limits were between

(15-42%), the optimum limits were between (25-46%), and the maximum limits were between (34-49%).

Recommendations

1. Encouraging building windbreaks to provide shade to protect the crop from solar glare, high temperatures, and damages from strong winds and dust storms.
2. Expanding the cultivation of grape trees and introducing new varieties due to the availability of appropriate climatic data in the study area.
3. Spreading awareness among the farmers through holding educational and guiding courses and seminars on the methods of agriculture and the optimum use of the land and the increase and development of production.

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