



## Geographical distribution of *Astragalus spinosus* (Forssk.) Muschl. in Southern Desert of Basrah/Iraq

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### Abstract

*Astragalus spinosus* (Fabaceae) is one of the important plants in the desert of southern Iraq, it was considered to have great environmental value. In this research, the plant was studied in the desert of Basrah southern Iraq (DSD) in terms of its geographical distribution in a comprehensive manner and survey of all regions of the southern desert during the years 2021-2023. Also, the air temperature, air humidity and soil moisture were studied in the four study areas which was Hamar Moshref, Artawi, Tuba, Sedra. The results of this study showed that *A. spinosus* extends in apparent densities in specific areas around the center of Zubair from the western side in Tuba and Artawi regions, then gradually decreases in the southeastern side of the center of Zubair, passing through Khur AlZubair, then Safwan, then Um Qasr. The plant is adapted to grow in all soils except in saline soils, where the species was not recorded. The results of air temperature showed that the highest degree which was 40°C in early summer at fourth station, and the highest degree of air moisture reached 48% during winter in first station, while soil moisture was 41% during spring in second station. It can be concluded that the plant is currently reduced due to a lack of precipitation and an increase in weather temperatures, which is caused by global warming and climate change, as well as increased pollution and animal overgrazing on the plant.

**Keywords:** *Astragalus spinosus*, Distribution, Basrah, Iraq.

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### Introduction

Deserts cover about 8.5 million km<sup>2</sup>, or 34% of the world's land area (Zeng and Yoon, 2009). The desert lands in Iraq are a wide area and constitute more than 60% of the total area (Thalen, 1979). Zubair region, which is the site of the study, in southwestern part of Basrah Governorate

in Iraq. The district consists of three main regions on the administrative side, which are the center of Zubair, the region of Safwan, and then Um Qasr. The geographical distribution of natural vegetation differs from one region to another in Zubair, and it may be scattered in places and dense in others where

moisture is present, as the average annual of rainfall is 110 ml. Zubair district is poor in vegetation cover (Al-Aqili, 2019). *Astragalus spinosus* is found in a large cosmopolitan and urban range, with a relatively large community, and grows on rocky soils and silt (Taifour and El-Oqlah, 2014). In addition, the temperature and precipitation are among the most important factors that control the geographical distribution of plants (Woodward, 1988). Townsend and Guest (1974) referred to *A. spinosus* (Forssk.) Muschl. as one of the most common plants in the Iraqi desert, it is considered to be available in desert areas and rare in wet steppe areas of northern Iraq, it is also present in most districts of Iraq. It has a great environmental value including protection of the land, prevent desertification and stabilization of sand dunes, and thus reducing sand coming from deserts to urban sites, especially in the summer season. The aim of this study was to survey the southern desert area in Basrah and determine the geographical distribution of *A. spinosus* and indicate its current condition, determination of environmental factors affecting the germination and distribution of *A. spinosus*.

### Materials and methods

Measurements of air temperature, air and soil moisture were studied seasonally, and plant samples were collected and kept in the herbarium of the University of Basrah (BSRA), that air temperature measured in the field at the four study stations by thermometer, air moisture measured in the field at the four study stations by hygrometer.

The water content of the soil was calculated, where soil samples were collected from all stations and for all study seasons to calculate the moisture

content in them, where the soil that is near the root of the plant taken from a depth of at least 10 cm, and immediately weighed in the field and placed in bags, closed and brought to the laboratory, then placed in the oven at a temperature of 105 °C for 24 hours, weighed, and repeated the process until the second weight is proven, then according to the equation soil moisture can be calculated:

$$\text{Soil moisture content} = \frac{\text{1st weight (wet soil)} - \text{2nd weight (dry soil)}}{\text{dry weight}} \times 100 \quad (\text{Nwogwu et al., 2018}).$$

### Study sites

The study was conducted in site of Zubair, southwest of Basrah, southern Iraq, chosen four elected and different sites in Zubair within spreading areas of *A. spinosus*, from autumn 2021 to spring 2023. The GPS device determined the geographical locations of these stations which was (Fig.1):

Station 1(S1): (30°29'11.04" N - 47°37'01.2" E) Hamar Moshref region northern Zubair, near to northern Shaibah, 1.6 km from the Basrah-Baghdad highway, and 16 km from Basrah International Airport.

Station 2(S2): (30°34'35.04" N - 47°06'13.68" E) Artawi, located to the northwest of Zubair, close to north Rumailah, 54 km from the site of Hamar Moshref. It is characterized by a large number of *A. spinosus* plants spread in the form of close groups along the study site. This area has depressions formed by rainwater in the winter.

Station 3(S3): (30°25'43.68" N - 47°27'44.28" E) Tuba, is 40 km from Artawi, towards the southeast of it. *A. spinosus* is found in it in a large and relatively sparse manner.

Station 4(S4): (30°27'16.56" N - 47°27'39.24" E) the fourth station, Sedra, which is at the beginning of Safwan Road, it is 17 km from Hamar Moshref site and 2.5 km from Sedra checkpoint. The geographical distribution was not limited to the four study stations but

included the desert areas in the west and southwest of Basrah and the areas surrounding Safwan, Um Qasr and Jirishan. The extent of the plant species spread was also studied.

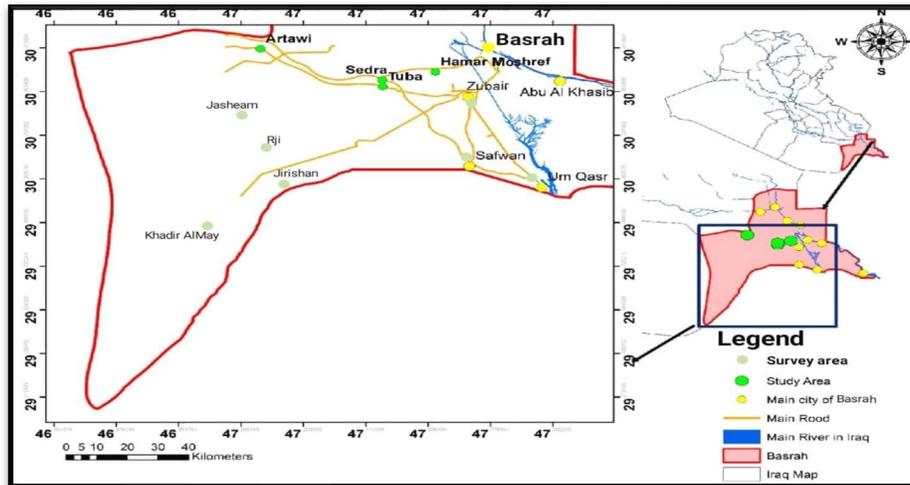


Fig. (1): Map of the study area.

**Results and Discussion**

The air temperature was recorded at the four stations in the months from 10/2021 to 9/2022.

Where the seasonal temperature changes showed the highest degree of 40° C during the summer at the fourth station and the lowest temperature was recorded at 10° C during the winter 2021/2022 at the first station.

And these temperature variations are what lead to the harsh conditions in the southern desert in Basrah and affect both

animal and plants species (Maleh, 2015; Al-Mayah *et al.*, 2016). Extreme temperatures and lack of water availability are also the most important factors limiting the production and activity of desert organisms and ecosystem processes in deserts (Noy-Meir, 1973, 1974; Whitford *et al.*,1981; Whitford *et al.*,1983), therefore, it is the mainly controller of desert environments and even minor variations of them lead to a total change in the existence and spread of a particular species (Fig. 2).

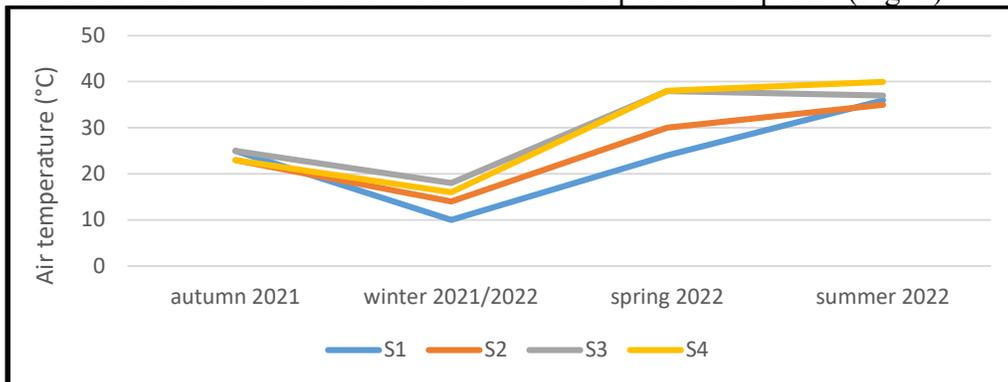


Fig. (2): Seasonal changes in air temperature (°C) of the study stations.

The values of air humidity during the seasonal changes showed a clear difference (Fig. 3), especially between the winter and summer seasons, where the highest value of air humidity was shown at the first station in the winter and reached 48%, while the lowest value of air humidity was at the first and third stations during the summer and reached 10%.

There has been a correlation between the increase in drought and desertification with higher temperatures in the summer, where the increase in heat lead to increase of drought, increased evaporation and less moisture in the atmosphere. This proves the severity of the drought occurring in the desert ecosystems in the hot seasons, as indicated (Al-Hussaniy, 2019).

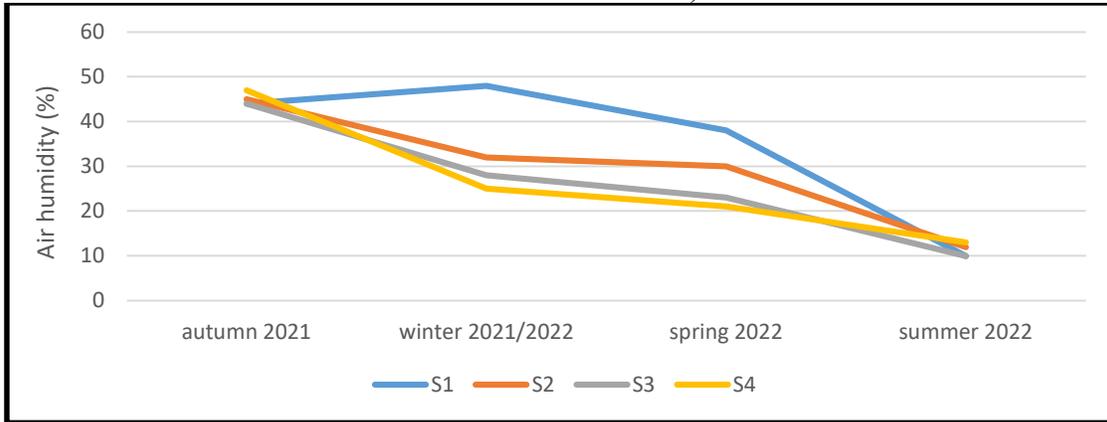


Fig. (3): Seasonal changes in air humidity (%) of the study stations.

The soil moisture values showed a clear variation between the four stations and for different seasons, and this is during 2021/2022, where the highest values in the second station in the spring were recorded at 41%, while the lowest values were recorded in the second station in the autumn at an average of 0.1%.

where the lack of precipitation during the study period was followed by hot early summer that lead to poor soil moisture as a result it was followed by a poverty of desert vegetation, transpiration may be the cause of depletion of soil moisture under the plant (Schlesinger, 1985), and this happens in the summer season and leads to a lack of water surrounding the roots (Fig. 4).

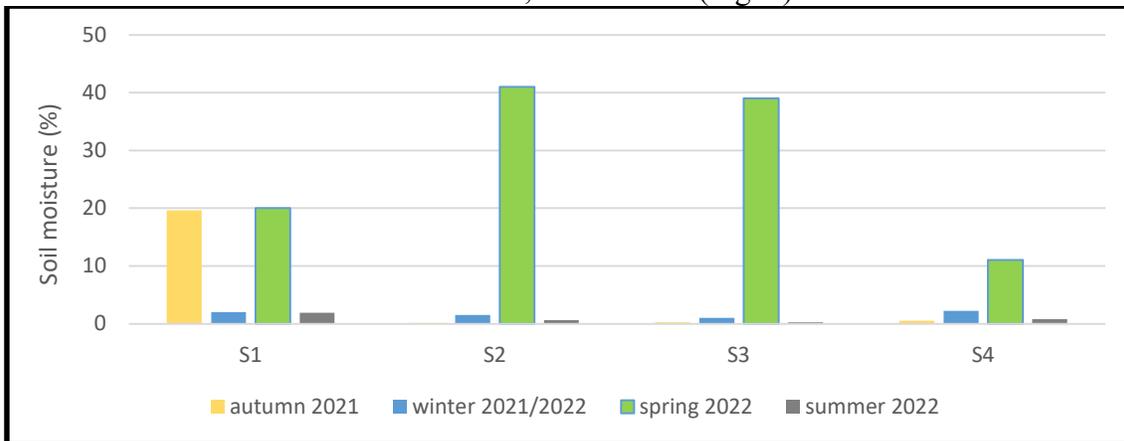


Fig. (4): Seasonal changes in soil moisture (%) of the study stations.

A periodic field follow-up was conducted during the period 10/2021-3/2023 to monitor and record the geographical distribution of the *A. spinosus*, by meaning the extent of the spread of the species in the desert, west and southwestern of Basrah.

It was found that the plant present in visible densities, which distinguishes the species from other desert plants, where in every 100 m 30 individuals are distributed in the first station, 90 individuals in the second station, 85 individuals in the third station, 200 individuals in the fourth station. So it is noticeable that the density of the species is concentrated in the area of its presence, and this differs from one region to another, so the density decreases in some and increases in others as shown in (Fig. 6).

Also this distribution is limited to environments of a nature that allows the plant to adapt with it includes sandy loam soils, as the plant was not recorded in the saline desert soils. In addition, the rain factor and the soil moisture directly determine the distribution of the plant, and this is in the study stations and the adjacent places, where the plant appears in very close and adjacent numbers in some places, and in other places the individuals are approximately two meters apart from each other within the limits of an area of 50 m.

It is noticeable that the plant *Astragalus spinosus* has decreased in numbers in recent years compared to what it was in 1974 according to (Townsend and Guest, 1974), the changes in temperature, which reach a very high temperature in the summer, reached 47.7 °C (Al-Hassan and Kadhim, 2022) affect the presence and distribution of the plant, which will lead

to eliminate it, combined with lack in the amount of rain with rate 55.6 ml in winter and 26.3 ml in spring according to (Hichel, 2020), the texture of the soil also has a major role in the distribution of the plant, this is why the plant was not recorded in the environment that has saline soils, also the plant does not grow in alluvial and clay soils, and thus the species was not recorded in it. Therefore, it is noticeable from the results of the current study have shown that the species exposure to a decrease in the numbers of its individuals and a decrease in its distribution and spread, and therefore the decrease in vegetation cover and an increase in desertification.

*A. spinosus* accompanied by other species such as *Artemisia* sp in Hamar Moshref region, and in Sedra region there were areas in which *A. spinosus* prevails and others lack its presence, with this species overlapping with other plants present within the station, especially *Artemisia* sp. Therefore, many desert plant communities will be affected by desertification.

The regions and villages of the southern desert which belongs to Zubair-Safwan-Um Qasr were determined (Fig. 5). This map was based on knowing the locations of the regions and villages by referring to the supervisor, as well as the inhabitants of these regions. Since the lack of maps that describing the areas of the southern desert in Basrah accurately to describe geographical locations and the distance between two points and to facilitate the distribution and accurate designation of plant species in their environments and natural habitats to be a scientific reference that the researchers based on, we designed the following map:

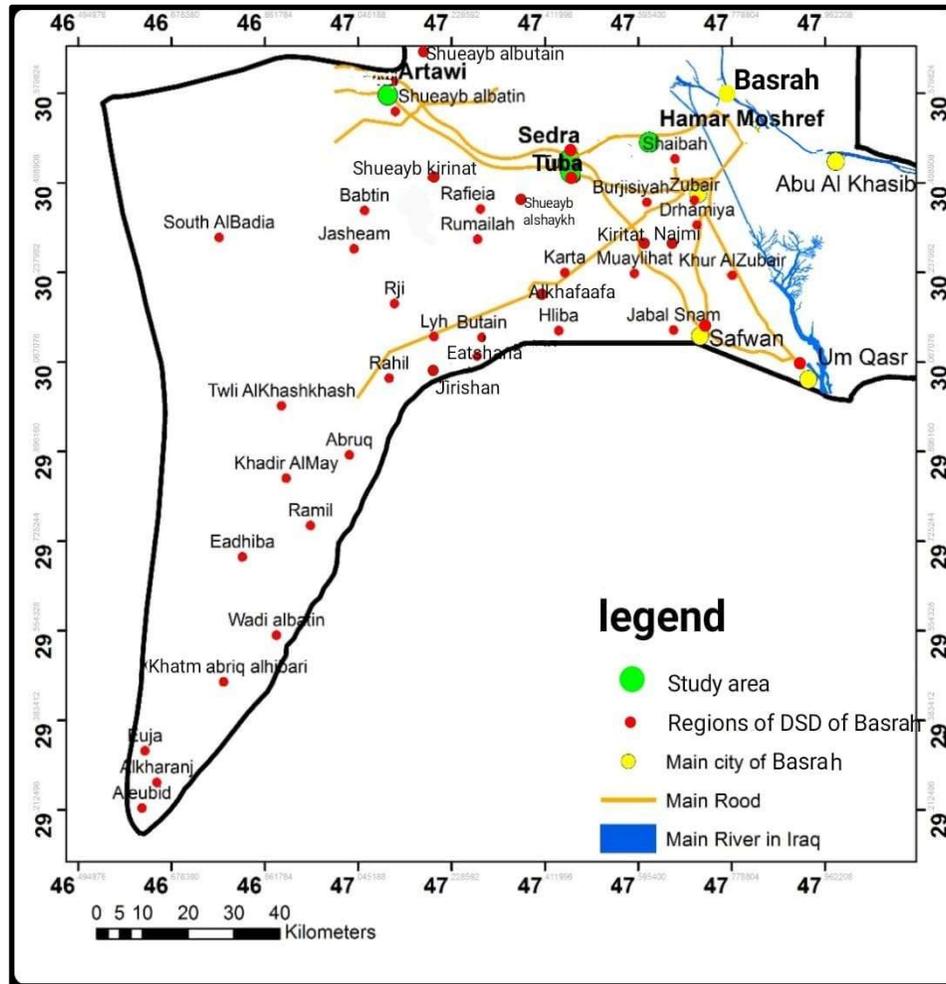


Fig. (5): Map of southern desert regions and villages of Basrah.



Fig. (6): *A. spinosus* distribution shows varying of densities in different areas in southern desert of Basrah.

Map (Fig. 7) indicated to *A. spinosus* distribution at the desert of Basrah southern Iraq (DSD), in further specialization, indicated the plant distribution points in the southern desert region in Basrah as shown (Fig. 8). It is notable that the points here do not mean to a single individual, but they mean a community of the desert plant *A. spinosus* referred to numbers ranging from 10-200 individuals at each point shown in the map, and it may be more due to the

harmonization of environmental conditions with breaking the seed dormancy at the ideal time to grow many communities of this plant to form in certain places in the southern desert, and there is rarely a single *A. spinosus* in a region as recorded solitary individual in Alluhais and in northern Jirishan, and the reason for this is due to the way the seeds dispersal to form a new single plant in an area empty of its companions (Li *et al.*, 2014).

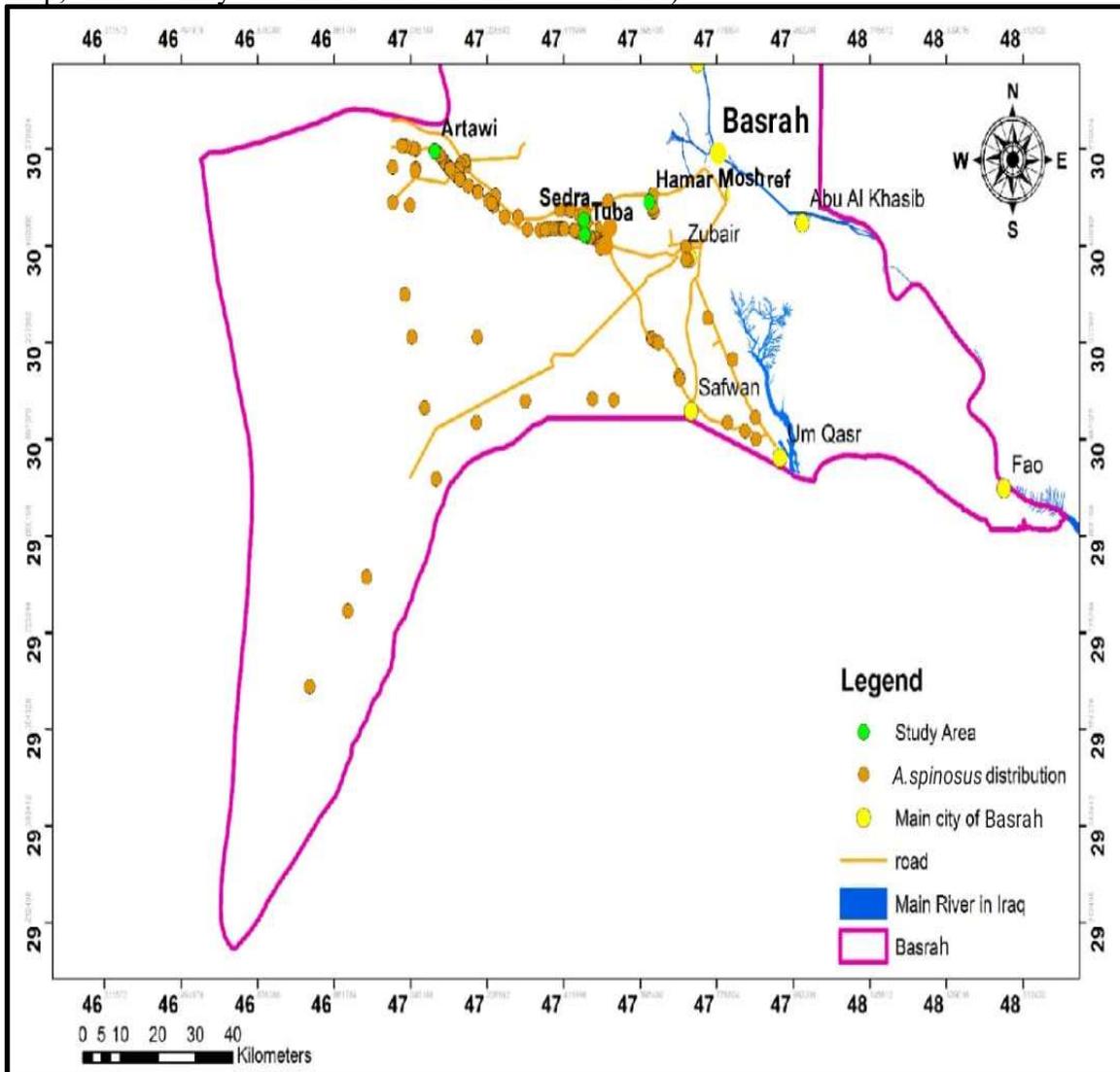


Fig. (7): Distribution of *A. spinosus* in the southern desert of Basrah.

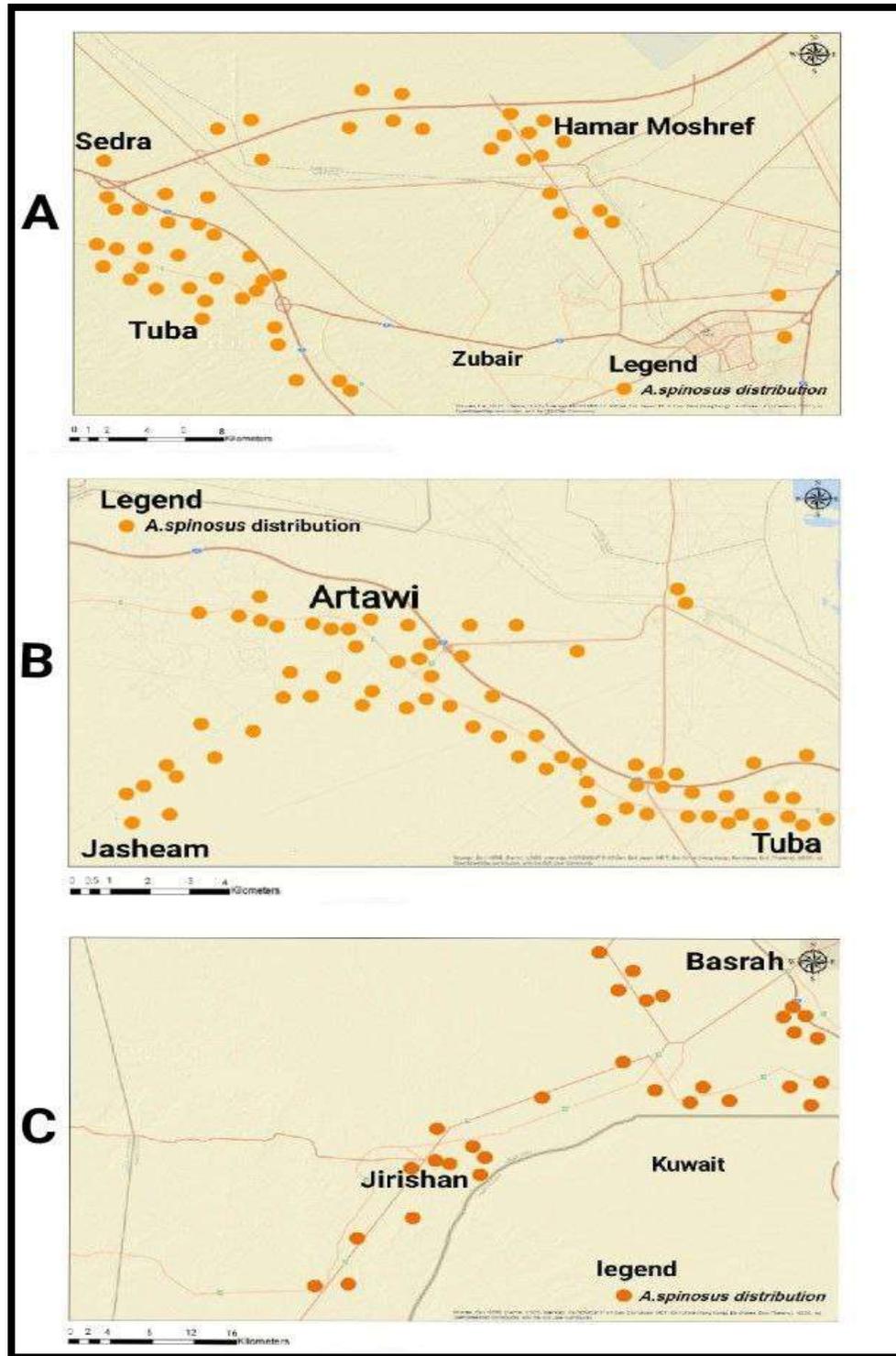


Fig. (8) A: Distribution of *A. spinosus* in northern Zubair in Basrah.  
B: Distribution of *A. spinosus* in northwest Zubair in Basrah.  
C: Distribution of *A. spinosus* in southwest Zubair in Basrah.

## Conclusion

One of the direct causes that affect *A. spinosus* distribution is the rise in temperatures because of global warming due to climate change, which led to the lack of moisture in the soil, that has a key role in the germination of seeds. Also,

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**التوزيع الجغرافي لنبات الطجيج *Astragalus spinosus* (Forssk.) Muschl. في الصحراء الجنوبية لمحافظة البصرة/العراق**

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**المستخلص**

يعد نبات الطجيج *Astragalus spinosus* من النباتات المهمة في البيئة الصحراوية العراقية حيث إن له قيمة بيئية كبيرة. وفي هذا البحث دُرِسَ النبات في البيئة الصحراوية في البصرة جنوب العراق (DSD) من حيث توزيعه الجغرافي بشكل شامل ومسح كامل لجميع مناطق الصحراء الجنوبية خلال 2021-2023، أيضاً دُرِسَتْ درجة حرارة الهواء في مناطق الدراسة الأربعة وهي حمار مشرف، ارطاوي، الطوبية، السدرة. وكذلك دُرِسَتْ رطوبة الهواء ورطوبة التربة. أظهرت النتائج ان النبات يمتد بكثافات ظاهرة في مناطق محددة حول مركز الزبير من الجهة الغربية في منطقة الطوبية وارتاوي ثم يقل تدريجياً في الجهة الجنوبية الشرقية من مركز الزبير مروراً بخور الزبير ثم سفوان ثم أم قصر، وإن النبات يتكيف للنمو في جميع الترب عدا الترب الملحية حيث لم يسجل النوع في هذه الترب. بلغت أعلى درجة حرارة للهواء 40 م° في بداية فصل الصيف في المحطة الرابعة، كما بلغت أعلى نسبة لرطوبة الهواء 48% في فصل الشتاء في المحطة الأولى، بينما أظهرت قيمة رطوبة التربة أعلى مقدار 41% في فصل الربيع في المحطة الثانية. يمكن الاستنتاج من الدراسة الحالية ان النبات قلّ عمومًا في الوقت الحاضر بسبب شحة مياه الامطار والحرارة الشديدة وسبب ذلك هو الاحتباس الحراري والتغيرات المناخية بالإضافة لذلك إزدياد التلوث وبسبب الرعي الجائر للحيوانات على النبات.