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Diversity and floristic study of weeds species in Tabuk region farms in Saudi Arabia

Siham Mohammed Al-Balawi[1], Mona Soliman Alwahibi[1], Nadi Awad Al-Harbi[2]
[1] Department of Botany and Microbiology, College of Science, King Saud University, Riyadh, Saudi Arabia
[2] Department of Biology, University College of Tayma, Tabuk University, Tabuk, Saudi Arabia

Abstract
The region of Tabuk is characterized by geographical diversity that ranges between coastal plain areas, mountainous areas, plateaus and desert areas. It has a dry desert climate with very little annual rainfall reaching 28.70 mm. In this study, we surveyed the growing weeds in a number of farms in the Tabuk region, and make a taxonomic comparison. This study will be a source of key information regarding the classification of weeds in terms of their positive or negative economic importance.
The area was divided into four sections, each one was divided into three sites, and each site was subdivided into ten squares with an area of one m^2. The plant species were identified and named according to the Flora Books of Saudi Arabia.
After studying the composition and distribution of weeds types in farms in the Tabuk region in the Kingdom of Saudi Arabia, the results showed that the number of plant species that were counted in the study area amounted to (69) plant species of vascular plants which belonging to (42) genera belonging to (20) families.

Keywords: Tabuk, diversity, plants, species, genera

Introduction
Tabuk region is one of the largest regions in Saudi Arabia in terms of area (about 136000 km^2), and it occupies 6.9% of the Kingdom's area (Geological Survey Authority, 1438) [1], and the region is characterized by geographical diversity that ranges between coastal plain areas, mountainous areas, plateaus and desert areas. It has a dry desert climate with very little annual rainfall reaching 28.70 mm (Hasanean and Almazroui, 2015) [2].
Tabuk region is famous for being one of the major agricultural areas in the Kingdom of Saudi Arabia (KSA), and agriculture is concentrated in the city of Tabuk, as 70% of the cultivated area in the region is located in and around the city of Tabuk. This may be due to the abundance of water in this city, where the city of Tabuk is considered the main source of water in the region, due to its geological nature, which is characterized by its ability to store water. It is also famous for its fertile agricultural soil, which is more than 1500 m above sea level. The Tabuk region produces 27% of the KSA's olive production. It is also famous for the production of dates, as the cultivated area and the total number of palm trees and fruitful ones of all varieties has maximized. The region has one factory, representing 1.8% of the total number of factories for dates and their derivatives in the KSA.
One of the most important challenges that can face farms is the occurrence of some defects that could reduce their productivity. This includes environmental damage or damage from human action, such as the scarcity of rainwater, which contributed to an increase in soil salinity and the consumption of non-renewable groundwater, which negatively affected agriculture as well (Rayan et al., 2020) [3].
Grass plants have evolved in the arable systems of the Old World over the centuries, thus supporting unique multispecies plant communities (Holzner and Immonen, 1982) [4]. Hence, investigations of weeds in these arable systems that have evolved over the centuries always delve into the many species, diversity, and societies they build. The task of arable weed surveys is different from the survey of environmental weeds mentioned (Barnett et al., 2007) [5], which they focus on invasive species in Northern Border of KSA only Osman et al., (2014), Osman and Abdein, (2019 a & b), Abdein and Osman, 2020 and Abdein et al., (2020) [6-10].
In this study, we will survey the growing weeds in a number of farms in the Tabuk region, and make a taxonomic comparison. This study will be a source of key information regarding the classification of weeds in terms of their positive or negative economic importance (such as weeds) to be a reference for any recent studies for modeling or predicting future changes to arable weeds on a large scale.

Materials and Methods
Study area
The current study was conducted on a number of farms in different parts of Tabuk region. Tabuk region is located in the northwest of the Kingdom of Saudi Arabia, bordered by the Red Sea to the west, it is situated 28.2453° N, 37.6387° E (Figure 1).

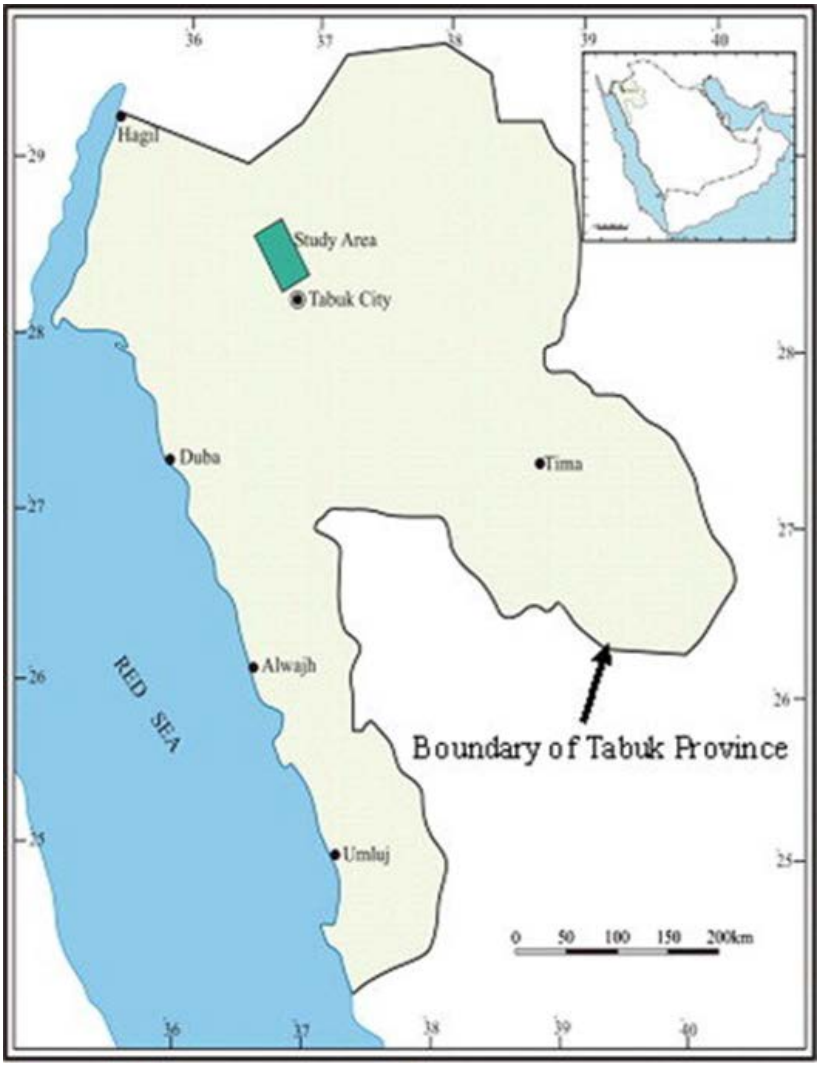

Fig 1: Map of Tabuk region, KSA. (Al-Harbi, 2010 [36]).

The region is characterized by a great diversity of geological structures (topography), which led to the containment of this region with many minerals and natural ingredients such as iron and granite (Al-Balawi, 2015) [11]. This area includes many morphological phenomena, including marine, plain, mountainous, valleys, and sand dunes. The percentage of areas covered by plateaus is 45.96%, mountains is 31.78% of the total area of the region. This topography represents a great indication of the nature of the geological structure of the region.

The climate of the Tabuk region is one of arid desert climates. Temperatures in summer average are up to 40 degrees Celsius and drop in winter to an average of 7.6 degrees with annual rainfall, about 28.70 mm. The sites and locations of the study area are shown in (Table 1).

Table 1: sites and coordinates of the study area and locations

Site name	Coordinates
Tabouk City	28°33'41.4"N 36°26'26.4"E 28°34'38.3"N 36°25'43.8"E
Bir Bin Harmas	28°50'57.6"N 36°17'16.9"E 28°50'37.5"N 36°16'52.6"E
Nashifa	26°58'48.4"N 37°11'19.3"E 26°58'57.0"N 37°11'13.0"E
Tayma	27°45'59.7"N 38°05'56.9"E

Survey method

1. Conducting intensive field trips to study the farms included in the study during the months of March-April-May of the year 2020 and the months of February-March-April of the year 2021.
2. The area was divided into 4 sections, and was subdivided into ten squares with an area of1 m2.
3. The plant species were identified and named according to the Flora Books of Chaudhary, 2001; Chaudhary and Al Jowaid, 1999; Chaudhary, 1999; Collenette, 1999). [12-15].

Data analysis

1. Plant coverage values for all plant species and for all sites were subjected to multi-directional analysis to classify sites into groups based on species cover values and using DECORANA, TWINSPAN, CANOCO.
2. The life forms of plant species were classified according to the Raunkiær system (Naqinezhad and Zarezadeh, 2013; Raunkiae, 1937) [16, 17].

Results

The plant species were counted in the study area in Tabuk region, the number of plant species that were counted in the study area amounted to (69) plant species of vascular plants, belonging to (42) genera and (20) families.

Plants of Tabuk city

Table (2) shows that the number of plant species that were counted in Tabuk City site amounted to about (19) plant species of vascular plants, belonging to (18) genera and (10) families.

Table 2: A list of plant species in Tabuk City farms.

Family	Species
Amaranthaceae	*Atriplex rosea*
	Bassia scoparia
	Caroxylon passerinum
	Halogeton glomeratus
Asteraceae	*Lactuca serriola*
	Oncosiphon pilulifer
	Santolina chamaecyparissus
	Sonchus oleraceus
	Taraxacum afficinalis
Chenopodiaceae	*Chenopodium album*
	Chenopodium murale
Convolvulaceae	*Convolvulus Arvensis*
Heliotropiaceae	*Heliotropium curassavicum*
Malvaceae	*Malva parviflora*
Poaceae	*Phragmites australis*
Resedaceae	*Reseda lutea*
Solanaceae	*Hyoscyamus muticus*
	Solanum douglasii
Zygophyllaceae	*Tribulus terrestris*

Plants of Bir Bin Harmas farms

Table (3) shows that the number of plant species that were counted in Bir Bin Harmas site amounted to about (18) plant species of vascular plants, belonging to (17) genera and (13) families.

Table 3: A list of plant species in Bir Bin Harmas farms.

Family	Species
Amaranthaceae	*Atriplex rosea*
	Beta vulgaris
	Ononis spinosa
Asteraceae	*Lactuca serriola*
	Sonchus oleraceus
Brassicaceae	*Diplotaxis tenuifolia*
	Raphanus sativus
Chenopodiaceae	*Chenopodium album*
	Chenopodium murale
Convolvulaceae	*Convolvulus Arvensis*
Fabaceae	*Medicago sativa*
Heliotropiaceae	*Heliotropium curassavicum*
Hydrophyllaceae	*Phacelia hastate*
Lamiaceae	*Thymus capitatus*
Malvaceae	*Malva Parviflora*
Polygonaceae	*Polygonum aviculare*
Solanaceae	*Solanum douglasii*
Zygophyllaceae	*Tribulus terrestris*

Plants of Nashifa farms

Table (4) shows that the number of plant species that were counted in Nashifa site amounted to about (35) plant species of vascular plants, belonging to (34) genera and (16) families.

Table 4: A list of plant species in AL Nashifa farms.

Family	Species
Aizoaceae	*Aizoon canariense*
	Mesembryanthemum crystallinum
Amaranthaceae	*Atriplex rosea*
	Kali tragus
Asphodelaceae	*Asphodelus fistulosus*
Asteraceae	*Calendula Arvensis*
	Calycoseris wrightii
	Chondrilla juncea
	Conyza bonariensis
	Coreopsis lanceolata
	Lactuca serriola
	Matricaria discoidea
	Pallenis maritime
	Sonchus oleraceus
	Stephanomeria pauciflora
Brassicaceae	*Brassica tournefortii*
	Diplotaxis tenuifolia
	Lepidium Sativum
	Lobularia maritime
	Morettia parviflora
Chenopodiaceae	*Chenopodium album*
Euphorbiaceae	*Euphorbia peplus*
	Euphorbia prostrate
Fabaceae	*Astragalus membranaceus*
Geraniaceae	*Erodium texanum*
Malvaceae	*Malvella leprosea*
	Malva parviflora
Plantaginaceae	*Linaria dalmatica*
	Plantago arenaria
Resedaceae	*Reseda lutea*
Sisymbriceae	*Sisymbrium irio*
Solanaceae	*Lycium arabicum*
Urticaceae	*Forsskalea tenacissima*
Zygophyllaceae	*Fagonia laevis*
	Zygophyllum simplex

Plants of Tayma farms

Table (5) shows that the number of plant species that were counted in Tayma site amounted to about (23) plant species of vascular plants, belonging to (22) genera and (13) families.

Table 5: A list of the Plants in Tayma farms

Family	Species
Asteraceae	*Conyza bonariensis*
	Helminthotheca echioides
	Reichardia tingitana
	Santolina chamaecyparissus
	Senecio glaucus
	Sonchus oleraceus
Chenopodiaceae	*Anabasis aphylla*
	Chenopodium album
	Chenopodium murale
Brassicaceae	*Eruca Sativa*
	Hirschfeldia incana
	Capsella bursa-pastoris
Cucurbitaceae	*Citrullus colocynthis*
	Cucumis prophetarum
Convolvulaceae	*Convolvulus Arvensis*
Asclepiadaceae	*Hoya caudate*
Euphorbiaceae	*Euphorbia maculate*
Fabaceae	*Ulex europaeus*
Heliotropiaceae	*Heliotropium curassavicum*
Lamiaceae	*Teucrium oliverianum*
Malvaceae	*Malva Parviflora*
Polygonaceae	*Emex spinosus*
Solanaceae	*Solanum douglasii*

Table 6: Plant species that have a presence in most farms and by 85%

Species	Family	Duration	Life-form
Lactuca serriola	Asteraceae	annual or biennial	Therophyte

Table 7: Plant species that have a presence in farms by 40-60%

Species	Family	Duration	Life-form
Atriplex rosea	Chenopodiaceae	annual	Therophyte
Chenopodium murale.	Chenopodiaceae	annual	Therophyte
Convolvulus arvensis.	Convolvulaceae	perennial	Geophyte
Malva parviflora.	Malvaceae	annual	Therophyte
Reseda lutea	Resedaceae	annual	Therophyte
Sonchus oleraceus.	Asteraceae	annual	Therophyte
Lactuca serriola.	Asteraceae	annual or biennial	Therophyte

Table 8: Plant species that have a presence in farms, with a percentage of about 30%.

Species	Family	Duration	Life-form
Capsella bursa-pastoris .	Brassicaceae	annual	Therophyte
Conyza bonariensis	Asteraceae	annual	Therophyte
Fagonia laevis.	Zygophyllaceae	perennial	Chamaephyte
Heliotropium curassavicum.	Boraginaceae	perennial	Therophyte
Santolina chamaecyparissus.	Asteraceae	perennial	Chamaephyte

Table 9: Plant species that have a presence in farms and at a rate of less than 15%.

Species	Family	Duration	Life-form
Astragalus membranaceus	Fabaceae	perennial	Therophyte
Beta vulgaris	Chenopodiaceae	annual	Therophyte
Calycoseris wrightii	Asteraceae	annual	Therophyte
Chenopodium album	Chenopodiaceae	annual	Therophyte
Chondrilla juncea	Asteraceae	annual	Hemicryptophyte
Cucumis prophetarum	Cucurbitaceae	perennial	Hemicryptophyte, climber
Diplotaxis tenuifolia	Brassicaceae	perennial	Chamaephyte
Emex spinosa	Polygonaceae	annual	Therophyte
Eruca sativa	Brassicaceae	annual	Therophyte
Euphorbia maculata	Euphorbiaceae	annual	Therophyte
Euphorbia peplus	Euphorbiaceae	annual	Therophyte
Forsskaolea tenacissima	Urticaceae	perennial	Chamaephyte
Helminthotheca echioides	Asteraceae	annual	Therophyte
Hirschfeldia incana	Brassicaceae	annual	Therophyte
Hoya caudata	Apocynaceae	perennial	Epiphytic climber
Kali tragus	Chenopodiaceae	annual	Therophyte
Linaria dolmalica	Scrophulariaceae	annual	Therophyte
Mesembryanthemum crystallinum	Aizoaceae	annual	Therophyte (succulent)
Morettia parviflora.	Brassicaceae	perennial	Chamaephyte
Oncosiphon pilulifer	Asteraceae	annual	Therophyte
Ononis spinosa	Fabaceae	perennial	Hemicryptophyte
Phacelia hastata.	Boraginaceae	perennial	Therophyte
Polygonum aviculare	Polygonaceae	annual	Therophyte
Senecio glaucus	Asteraceae	annual	Therophyte
Sisymbrium irio.	Brassicaceae	annual	Therophyte
Taraxacum afficinalis.	Asteraceae	perennial	Therophyte
Tetraneuris linearifolia	Asteraceae	annual	Therophyte
Teucrium oliverianum	Lamiaceae	perennial	Chamaephyte
Thymus capitatus	Lamiaceae	perennial	Chamaephyte
Tribulus terrestris	Zygophyllaceae	annual	Therophyte
Ulex europaeus	Fabaceae	perennial	Chamaephyte (evergreen)
Zygophyllum smiplex	Zygophyllaceae	annual	Therophyte

Plant community structure

The results showed a summary of the total number of families, genera, species, and types of growth and life forms of plants registered in study area. It is clear that the annual plants that were recorded in the study area are more than the perennial ones. The annual plants represent 63.6%, while the perennial plants are 36.4%. By calculating the index of species/genera 44/42 = 1.04 and genera/genera 42/17 = 2.47. These low percentages indicate the high taxonomic diversity in study area. The results also showed that the predominant families in the study area are Amaranthaceae and Asteraceae, followed by Solanaceae with 18.2%, then Chenopodiaceae, Convolvulaceae, Gramineae, Heliotropiaceae, Malvaceae, Resedaceae, and Zygophyllaceae with 6.8% each.

The results also showed that most of the plant species prevalent in study area belong to the compound family Asteraceae, which was represented by 11 plant species at a rate of 25%, followed by the Brassicaceae family, which was represented by six plant species with a percentage of 13.64%, then the Chenopodiaceae family, represented by five types of plants by 11.36%. It was also found that there are two families, each containing three plant species, at a rate of 6.82% for each, which are family Fabaceae and Zygophyllaceae.

The number of families represented by five species was two families, Amaranthaceae and Asteraceae, with a rate of 4.55% for each species. The number of families represented by two species was only one family, which is Solanaceae and the rest of the plant families in the study area have one plant species.

The presence of plants for all studied farms was counted, and their relative frequency was also calculated. It showed the number of species and the percentage of each, the number of genera and plant species that were monitored in study area. It is clear that the species *Lactuca serriola* recorded the highest percentage of presence in study area. It is an annual herbaceous plant belonging to the compound family Asteraceae. Follows is (7) plant species with a high

percentage of presence (40-60%), including (5) annual herbs, namely *Atriplex rosea*, *Chenopodium murale*, *Malva parviflora*, *Reseda lutea*, *Sonchus oleraceous* and one perennial plant, *Convolvulus arvensis*. There are (5) plant species that had a frequency of about 30%, of which (3) are perennial species, which are *Fagonia laevis*, *Heliotropium curassavicum* and *Santolina chamaecyparissus*, and two types of annual herbs are *Capsella bursa-pastoris* and *Conyza bonariensis*, thirty two plants recorded the lowest values with a presence rate of less than 15%, of which (12) perennial plant species and (20) annual plant species.

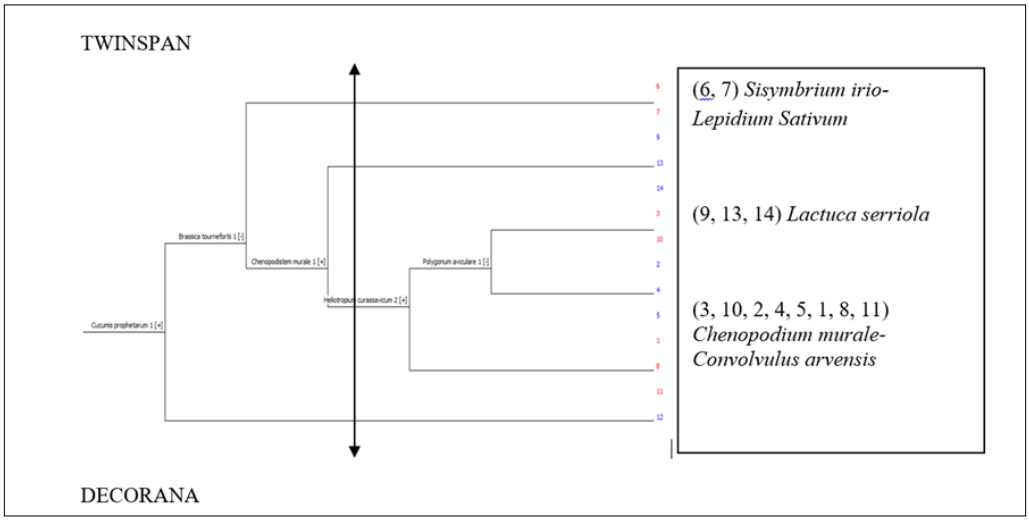

Fig 2: Plant groups using the Contrastive Segmentation Program (TWINSPN, A)

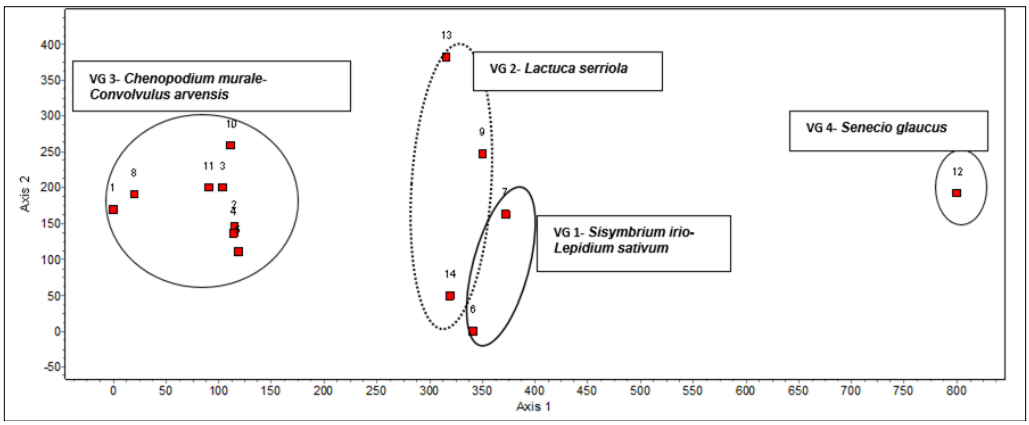

Fig 3: Coordination of the studied sites using the DCA coordination program

Discussion

The results confirmed that the number of plant species that were counted in the study area was 69 plant species of vascular plants belonging to 42 genera belonging to 20 families follow, spread in Tabuk region farms.

These results came close to what Al-Harbi 2021 and Aljeddani et al. 2021 [18, 19] found in his study on vegetation cover in Tabuk. The number of plant species in olive farms reached 51 plant species, of which 44 belong to 42 genera belonging to 20 plant families. These results agreed with Al Harbi 2005 and Al-Harbi 2017 a, b &c [20-23]. The number of plant species in four different locations of olive farms in the Tabuk region reached 46 plant species. However, these statistics differed in our study from what Al-Qahtani [24] found. The number of plant species in citrus farms in Tabuk reached 36 plant species. This difference in number may be due to the difference in area. The study and the diversity in herbs are due to the abundance of water in the Tabuk region and its geological nature, which is characterized by its ability to Water storage and highly fertile agricultural soil. The study made it clear that most of the plant species prevalent in the olive farms in Tabuk belong to the complex family Asteraceae accounted for 20.45%, followed by the Asteraceae family, with a percentage of 13.64%, then the cruciferous family Brassicaceae with 11.36%. These results were in agreement with the results of a number of studies that were carried out on different farms in the Kingdom, including Al-Qahtani [24] study.

The most common families were the compound family Asteraceae, the Brassicaceae family, and the Chenopodiaceae family. It also coincides with what was stated in the study of Gomaa [25], which indicated that the most prevalent species are the compound family Asteraceae and the Chenopodiaceae family. Also from the studies that support the spread of these families is the Shawky and Alzamel [26] study. The reason may be due to the spread of these species, which are among the most. The species are widespread in the flora of the Kingdom of Saudi Arabia, that their seeds and fruits are characterized by air dispersal, as they are light El-Sheikh, 2013 [27].

Two plant families were present at a rate of 6.82%, one of them is the marshmallow family Malvaceae and the other is the Solanaceae family. The spread of these two species came due to the availability of suitable environmental

conditions for their growth in terms of temperature and light, as it is one of the species spread in many temperate and tropical regions Shehata, 2014[28]. The Solanaceae family is one of the flourishing species spread in Tabuk and most of its related species annual plants that grow as soon as they have the appropriate conditions for growth, Onen et al., 2018 [29].

The proportion of a number of other families reached 4.55%, which are Amaranthaceae, Fabaceae, and Zygophyllaceae.

The species are among the widespread species in the flora of the Kingdom of Saudi Arabia. The species represented by only one species are at the fore Aizoaceae, Boraginaceae, Convolvulaceae, list of plant families in the study area, namely Cucurbitaceae, Euphorbiaceae, Geraniaceae, Lamiaceae, Liliaceae, Plantaginaceae, Resedaceae and Poaceae, Polygonaceae.

After counting the presence of plants for all studied farms, and calculating the relative frequency of them, it was found that sawn lettuce; *Lactuca serriola* recorded the highest percentage of presence in Tabuk region. It is an annual herbaceous plant belonging to the compound family Asteraceae. The high percentage of its prevalence in those farms may be due to the appropriate climatic conditions as mentioned in a study (Chadha et al.,[30], and this type is characterized by high efficiency in the use of water under drought conditions, which gives it the ability to expand its range in a dry climate, and its fruits have appendages that help them spread by the wind, and the temperature is suitable for the growth of this species, as stated in a study D' Andrea et al., [31].

In general, it turned out that the annual plants recorded in the study area are more than the perennial ones, where the annual plants represent about 56.8%, while the perennial plants are 43.2%. This may be due to the existence of a suitable environment for the growth of some plants in the rainy season. The predominant lifestyle in study area is Therophytes 70.4%, followed by other lifestyles. These results are in agreement with the Alhaithloul study 2019 a & b [32, 33], Al-Harbi, *et al.,* 2019 & 2021[37, 38], Alqahtani, *et al.,* 2020 [39].

The types of lifestyle Therophytes recorded 64%. The same was stated in the study of El-Ghanim et al. [34], where the predominant pattern in study area was Therophytes with a percentage of 49.2%. The difference in percentages is due to the difference in study area, and another study supports this result, as the prevailing pattern in study area is Therophytes 43.14%, due to the prevalence of Moawed, [35]. This pattern is the increase in temperature and the decrease in the amount of rain.

Conclusion

After studying the composition and distribution of weeds types in study area in Tabuk region in the Kingdom of Saudi Arabia, the results showed that the number of plant species that were counted in the study area amounted to (69) plant species of vascular plants, belonging to (42) genera and belonging to (20) families in Tabuk region farms and this study recommends conducting studies on the effect of these plants on farm crops.

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