

Floristic analysis of wild plant communities infested with the parasitic plant *Cuscuta planiflora* in Riyadh Region, Saudi Arabia

Majed A. Alotaibi¹, Abdulaziz M. Assaeed¹, Ahmed M. Abd-ElGawad^{1,2,*}

¹ Plant Production Department, College of Food & Agriculture Sciences, King Saud University, Saudi Arabia

² Department of Botany, Faculty of Science, Mansoura University, Mansoura 35516, Egypt

* Correspondence to: aibrahim2@ksu.edu.sa, dgawad84@mans.edu.eg; Tel.: +201003438980

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Abstract The current study investigates the floristic aspects of the plant communities infested with the parasitic plant *Cuscuta planiflora* in the Riyadh Region, Saudi Arabia, including a list of plant species, duration of documented species, life-form spectra, and phytochorotype of the plant life. Floristically, the total number of the recorded flowering plant species in the present study is 116, belonging to 92 genera and 26 families. According to the plant duration, these species are 65 perennial species (56.03%), 50 annual species (43.10%), and only one species biennial of the total plant species. Asteraceae, Brassicaceae, Poaceae, Fabaceae and Caryophyllaceae are the main families being represented collectively by 75 species or approximately 64.66% of the total number of the recorded species. The recorded species are classified under 6 types of life-form according to the Raunkiaer system (Raunkiaer 1934) therophytes, chamaephytes, hemicryptophytes, phanerophytes, geophytes and parasite. The floristic analysis of the research region indicates that Saharo-Arabian (mono-regional with 26.72%), bi-regional species with 26.72% and plurioregional species with only species (0.86%). In addition, Irano-Turanian and Saharo-Arabian, Saharo-Sindian phytochoria possessed 16 and 21 plant species.

keywords: KSA; Riyadh Region; floristic survey; flora; chorotype.

1. Introduction

The environment where plants live is full of a wide range of diverse herbivores, such as insects, nematodes, fungi, bacteria, and oomycetes, as well as microbial illnesses. Plants have evolved defenses that allow them to recognize such attacks and efficiently fend them off [1]. Plants are parasitized by other plants in addition to microbial diseases and herbivorous arthropods. A taxonomically varied group of angiosperms known as parasitic plants rely fully or mostly on their hosts for resources including water, nutrients, and carbon. They do this by attaching to their roots or shoots using specialized structures called haustoria, penetrating their xylem, and/or establishing close connections with their phloem. The parasite can be categorized as either a root parasite or a shoot parasite depending on where it attaches to the host [2].

From tropical rain forests to the high Arctic, parasitic plants are common. They make about 1% of all angiosperm species (between 3000 and 4000), and they are found in over 270 taxa and 20 families [3]. They can be found in a wide range of organisms, including annual and perennial herbs (such as *Rhinanthus* species and *Bartsia* species), vines (such as *Cuscuta* species and *Cassytha* species), shrubs (such as *Oxalis* species and mistletoes), and trees (such as *Okoubaka aubrevillei*, which are sandlewoods) [5]. In Saudi Arabia, the distribution and host range of 31 species and infraspecific taxa of parasitic angiosperms from seven families are reviewed [6]. The bulk of these parasitic plants are found in the Southern regions, especially those from the families Convolvulaceae, Loranthaceae, Orobanchaceae, and Scrophulariaceae.

The performance of the host is frequently drastically reduced by parasitism, which affects the competitive interactions between the host and nonhost plants and has an impact on community structure, diversity, vegetation cycle, and zonation [7]. There are more than 20 plant families and 3,900 documented parasitic plant species among flowering plants. *Cuscuta* species from the Convolvulaceae family, are well-known and agriculturally important genera [8]. Though *Cuscuta* species may be found on all continents, they do best in areas with a warm and humid climate [9]. The Convolvulaceae family has only one parasitic genus, *Cuscuta*, and there is high match among the species within this genus. Typically, parasitic plants of the genus *Cuscuta* contain little to no chlorophyll or none at all. [10].

Cuscuta planiflora Ten. (Hamoul) is a parasitic plant that depends on other plants to obtain water, food and other elements that it needs for its growth and reproduction, thus the most important and most dangerous species in family Convolvulaceae. It has a yellow or orange to reddish filamentous, branched, coiled stem. *C. planiflora* has no roots or ordinary leaves, has small flowers, does not contain chlorophyll, and sends specialized organs to the tissues of the host, whose function is to absorb water and other nutrients. Its distribution in many different regions and habitats in the world and in general parasitizes both agricultural and wild plants and reproduces by producing thousands of seeds that can stay in the soil for many years before growing until the right conditions are provided. *C. planiflora* is considered a fast growing and spreading plant, which in turn leads to great economic losses and the deterioration of the vegetation cover in general in all the areas where it is found [11,12].

It is worth mentioning here that there are very few studies regarding the effect of some species of the genus *Cuscuta* on vegetation cover in natural habitats. However, there are no environmental studies on the distribution and spread of *Cuscuta planiflora* and its impact on the natural vegetation cover in the world as well as in the Kingdom of Saudi Arabia, hence the importance of this study.

2. Materials and Methods

2.1. Study area

A large country, Saudi Arabia makes up nearly 80% of the area of the Arabian Peninsula. The Riyadh region, which occupies the eastern portion of the Najd Plateau and has an area of roughly 38,000 km², is the core region of Saudi Arabia (Fig. 1). It is situated between longitudes 41° 48' and 48° 14' E and latitudes 19° 29' and 27° 28' N. (Figure 1). Geo-morphological appearance of Riyadh region include Rock formations of the Tuwaiq Mountains, which have an elevation of 1062 m, as well as sporadic regions of sand dunes between escarpments of the plateau and in the region's northern and southern portions [13,14]. The climate is defined by high summer temperatures of 33–37 °C, moderate winter temperatures of 14–17 °C, and humidity levels of 17% and 47% for summer and winter, respectively. The majority of the annual precipitation, which ranges from 90 to 137 mm, occurs in the winter (December–February). Rainfall is usually considered to be a rare occurrence in the area. The area near Riyadh is the driest in terms of these qualities [15].

2.2. Study and analysis of vegetation cover

After field surveys were carried out in the Riyadh region from February to April 2021 to collect plant specimens. The distribution of the 18 stands chosen for floristic composition studies in the Riyadh region is shown in Table 1. Squares having a surface size of 100 m² were created at each site. The stands were placed across the research region to cover a variety of habitats and to guarantee that a diverse range of vegetational variables was sampled. The taxonomy of living forms used in this study was based on Raunkiaer's [16] system of classification. Migahid [17], Chaudhary [18–20], and Collenette [21] were consulted for classification, identification, nomenclature, and chorotype.

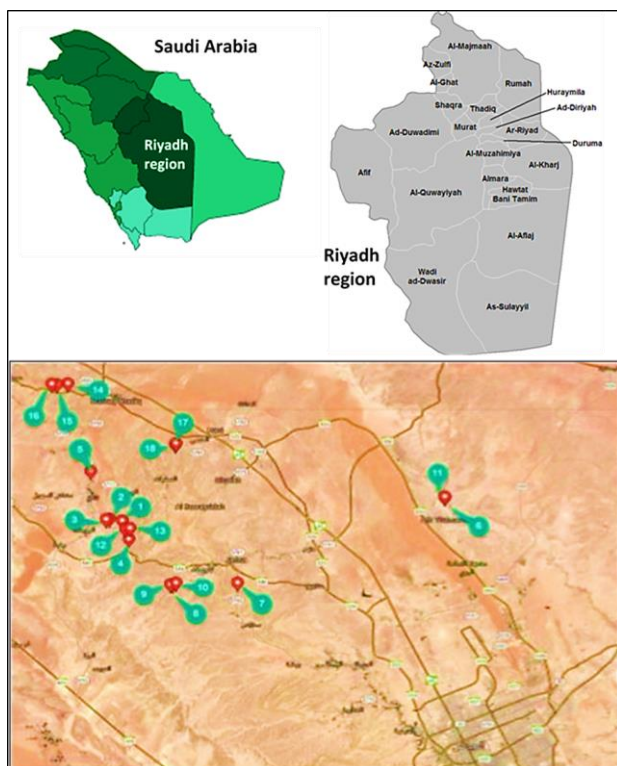


Figure 1: Map showing the study area (Wadi Mukheil, Alkharij Province, KSA).

Table 1. Number and coordinates of sites in the study area.

Stands	Location	Lat./long.
S1	Thadiq	25.209316, 45.933441
S2	Thadiq	25.213028, 45.905614
S3	Ruwaida	25.212317, 45.899101
S4	Huraymila	25.166410, 45.947114
S5	Thadiq	25.321770, 45.865709
S6	Thumamah	25.261167, 46.623500
S7	Al Qurainah	25.067547, 46.180338
S8	Huraymila	25.063559, 46.041099
S9	Huraymila	25.064337, 46.036423
S10	Huraymila	25.066831, 46.047928
S11	Thumamah	25.263468, 46.623340
S12	Ruwaida	25.190805, 45.940132
S13	Ruwaida	25.192056, 45.949541
S14	Audat Sudair	25.520127, 45.817270
S15	Audat Sudair	25.518596, 45.793112
S16	Audat Sudair	25.519270, 45.782806
S17	Alhisi	25.381200, 46.047455
S18	Alhisi	25.384165, 46.048572

3. Results and Discussion

3.1. Floristic analysis of the study area

Table 1 provides a list of the plant species discovered at the several surveyed sites in Riyadh regions, along with details on their life span, plant families, Raunkiaer life forms, and regional distribution of plants. 116 plant species have been identified in the study area.

Numerous studies have shown that a variety of environmental factors, including temperature, rainfall, topography, morphometric variables, soil composition, and others, can affect how plants are distributed geographically and what conditions are best for their growth. One of the most significant factors affecting how plants are distributed on the surface of a ball is temperature.

According to the plant duration, these species are divided into three main categories, as seen in Figure 2, with 65 perennial species (56.03%), 50 annual species (43.10%), and only one species biennial of the total plant species present in the research region. The perennial plant species are mostly herbaceous either with woody base or with tuberous underground parts and few are shrubs. The Riyadh region's plant cover has a permanent quality because to the prevalence of perennial species ($\geq 50\%$). This may be attributed to the relatively little rainfall, which prevents the emergence of numerous annuals [22,23]. In addition, the high percentage of annual species ($>40\%$) this may be due to the time of study and climatic variables in the study area. This agreed with numerous studies obtained in different regions of Saudi Arabia such as Mossalam [24] in Taif, and Alatar et al. [25] in AlJufair wadi, Fadl et al. [26] in wadi Elkor, Sarawat Mountain. Shaltout et al. [27] and Wafa'a [28] reported that annuals dominant over perennials species in coastal lowland vegetation in eastern Saudi Arabia and az Zakhnuniyah Island, Arabian Gulf, respectively.

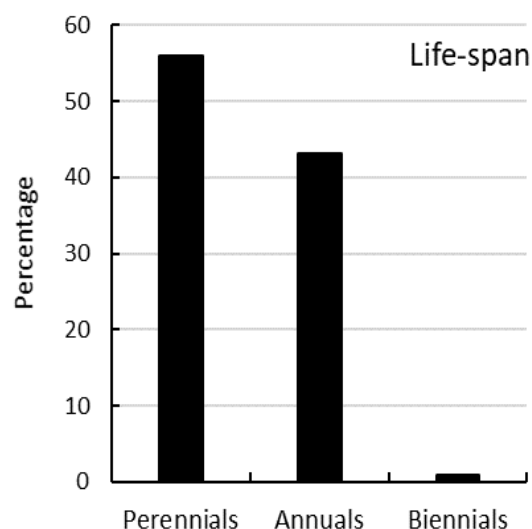


Figure 2: Plant life span in the study area

Table 1. Plant species documented of the different environments in the study area.

No.	Plant Name	Family	Life-form	Chorotype
Perennials				
1	Acacia ehrenbergiana Hayne	Fabaceae	Ph	SA+S-Z
2	Acacia gerrardii Benth.	Fabaceae	Ph	S-Z
3	Acacia tortilis (Forssk.) Hayne	Fabaceae	Ph	SU
4	Aeluropus lagopoides (L.) Thwaites	Poaceae	H	IR-TR+SA
5	Aerva javanica (Burm.f.) Juss. ex Schult.	Amaranthaceae	Ch	SA-SI+S-Z
6	Ammosperma cinereum (Desf.) Baill.	Brassicaceae	Th	SA
7	Anvillea garcinii (Burm.f.) DC.	Asteraceae	Ch	SA
8	Artemisia herba-alba Asso	Asteraceae	Ch	IR-TR
9	Artemisia monosperma Delile.	Asteraceae	Ch	ME+SA-SI
10	Nauplius graveolens (Forssk.) Wiklund.	Asteraceae	Ch	ME+SA-SI
11	Bassia arabica (Boiss.) Maire & Weiller	Chenopodiaceae	Ch	SA
12	Blepharis ciliaris (L.) B.L.Burt	Acanthaceae	Ch	IR-TR+SA
13	Cenchrus ciliaris L.	Poaceae	H	SA
14	Chondrilla juncea L.	Asteraceae	H	ME+IR-TR
15	Citrullus colocynthis (L.) Schrad.	Cucurbitaceae	H	SA
16	Cynodon dactylon (L.) Pers.	Poaceae	G	PAN
17	Deverra tortuosa (Desf.) DC.	Apiaceae	Ch	SA-SI
18	Diplotaxis acris (Forssk.) Boiss.	Brassicaceae	Ch	ME+SA
19	Echinophora spinosa L.	Asteraceae	Ch	ME
20	Echinops spinosissimus Turra	Asteraceae	H	ME+SA-SI
21	Fagonia arabica L.	Zygophyllaceae	Ch	SA-SI
22	Fagonia bruguieri DC.	Zygophyllaceae	Ch	SA
23	Farsetia aegyptia Turra	Brassicaceae	Ch	SA-SI+S-Z
24	Fumana laevipes (L.) Spach	Cistaceae	Ch	IR-TR+SA
25	Gymnocarpus decandrus Forssk.	Caryophyllaceae	Ch	SA
26	Gypsophila capillaris (Forssk.) C.Chr.	Caryophyllaceae	Ch	IR-TR+SA-SI
27	Haloxylon salicornicum (Moq.) Bunge ex Boiss.	Chenopodiaceae	Ch	SA-SI
28	Helianthemum lippii (L.) Dum.Cours.	Cistaceae	Ch	SA+SU
29	Heliotropium digynum Asch. ex C.Chr.	Boraginaceae	Ch	SA
30	Indigofera oblongifolia Forssk.	Fabaceae	Ch	SU
31	Lactuca viminea (L.) J.Presl & C.Presl	Asteraceae	H	ME+IR-TR
32	Lasiurus scindicus Henrard	Poaceae	G	SA+SU
33	Launaea arborescens (Batt.) Murb.	Asteraceae	Ch	ME+SA
34	Launaea lanifera Pau	Asteraceae	Ch	ME+SA
35	Launaea mucronata (Forssk.) Muschl.	Asteraceae	H	ME+SA-SI
36	Medicago marina L.	Fabaceae	Ch	ME
37	Nitraria retusa (Forssk.) Asch.	Zygophyllaceae	Ph	SA
38	Noaea mucronata (Forssk.) Asch. & Schweinf.	Chenopodiaceae	Ch	IR-TR
39	Ochradenus baccatus Delile	Resedaceae	Ph	SA-SI
40	Ochthochloa compressa (Forssk.) Hilu	Poaceae	Ch	SA
41	Panicum turgidum Forssk.	Poaceae	H	SA+SU
42	Peganum harmala L.	Zygophyllaceae	H	IR-TR+SA
43	Pentanema divaricatum Cass.	Asteraceae	H	IR-TR+SA
44	Pergularia tomentosa L.	Asclepiadaceae	Ch	SU
45	Plantago albicans L.	Plantaginaceae	H	ME+SA
46	Polycarpha repens Asch. & Schweinf.	Caryophyllaceae	Ch	SA-SI
47	Polygala erioptera DC.	Caryophyllaceae	H	SU
48	Pulicaria arabica (L.) Cass.	Asteraceae	H	SA
49	Pulicaria glutinosa (Boiss.) Jaub. & Spach	Asteraceae	Ch	IR-TR+SA
50	Pycnocycla nodiflora Decne. ex Boiss.	Apiaceae	Ch	ME+IR-TR
51	Pulicaria undulata (L.) C.A.Mey.	Asteraceae	Ch	SA+SU
52	Rhanterium epapposum Oliv.	Asteraceae	Ch	SA
53	Rhazya stricta Decne.	Apocynaceae	Ch	SA+SU
54	Scrophularia deserti Delile	Scrophulariaceae	Ch	SA
55	Scrophularia hypericifolia Wydler	Scrophulariaceae	Ch	SA-SI
56	Senna italica Mill.	Fabaceae	Ch	SU
57	Stipagrostis ciliata (Desf.) De Winter	Poaceae	H	SA+IR-TR+SU
58	Stipagrostis obtusa (Delile) Nees	Poaceae	H	SA
59	Stipagrostis pungens (Desf.) De Winter	Poaceae	Th	SA
60	Thelesperma megapotamicum (Spreng.) Kuntze	Asteraceae	Ch	SA
61	Trifolium fragiferum L.	Papilionaceae	H	SA
62	Teucrium oliverianum Ging. ex Benth.	Lamiaceae	Th	IR-TR
63	Zilla macroptera Coss.	Brassicaceae	Ch	SA

64	Zilla spinosa (L.) Prantl	Brassicaceae	Ch	SA-SI
65	Zygophyllum coccineum L.	Zygophyllaceae	Ch	SA-SI
Biennials				
66	Launaea capitata (Spreng.) Dandy	Asteraceae	Th	SA-SI+ S-Z
Annuals				
67	Adonis dentata Delile	Ranunculaceae	Th	IR-TR+SA
68	Aristida adscensionis L.	Poaceae	Th	SA+SU
69	Astragalus mollissimus Torr.	Fabaceae	Th	SA
70	Bassia eriophora (Schrud.) Asch.	Chenopodiaceae	Th	SA+SU
71	Brassica tournefortii Gouan	Brassicaceae	Th	ME+IR-TR+SA-SI
72	Cakile maritima Scop.	Brassicaceae	Th	ME+ER-SR
73	Cakile arabica Velen.	Brassicaceae	Th	SA
74	Caylusea hexagyna (Forssk.) M.L.Green	Resedaceae	Th	SU
75	Cleome amblyocarpa Barratte & Murb.	Capparaceae	Th	SA+SU
76	Crepis aspera L.	Asteraceae	Th	ME
77	Cuscuta planiflora Ten.	Convolvulaceae	P	ME+SA
78	Cycloloma atriplicifolium (Spreng.) Coult.	Amaranthaceae	Th	ME+SA
79	Daucus carota L.	Apiaceae	Th	ME
80	Daucus littoralis Sibthorp & Smith	Apiaceae	Th	ME
81	Didesmus aegyptius (L.) Desv.	Brassicaceae	Th	ME
82	Diploaxis harra (Forssk.) Boiss.	Brassicaceae	Th	ME+ SA-SI
83	Eleusine indica (L.) Gaertn.	Poaceae	Th	PAL
84	Emex spinosa (L.) Campd.	Polygonaceae	Th	ME+SA-SI
85	Erucaria hispanica (L.) Druce	Brassicaceae	Th	ME
86	Fagonia indica Burm.f.	Zygophyllaceae	Th	SA
87	Filago desertorum Pomel	Asteraceae	Th	IR-TR+SA
88	Gastrocotyle hispida (Forssk.) Bunge	Boraginaceae	Th	IR-TR+SA
89	Gymnocarpus sclerocephalus (Decne.) Dahlgren & Thulin	Caryophyllaceae	Th	SA
90	Helianthemum ledifolium (L.) Mill.	Cistaceae	Th	ME
91	Horwoodia dicksoniae Turrill	Brassicaceae	Th	SA-SI
92	Hypocoum pendulum L.	Papaveraceae	Th	ME+IR-TR
93	Isatis lusitanica L.	Brassicaceae	Th	ME+IR-TR
94	Laphangium luteoalbum (L.) Tzvelev	Asteraceae	Th	IR-TR+SA
95	Lappula spinocarpus (Forssk.) Asch. ex Kuntze	Boraginaceae	Th	IR-TR+SA
96	Launaea angustifolia (Desf.) Kuntze	Asteraceae	Th	SA
97	Lolium rigidum Gaudin	Poaceae	Th	ME+IR-TR
98	Malcolmia africana (L.) R.Br.	Brassicaceae	Th	IR-TR+SA
99	Malva parviflora L.	Malvaceae	Th	ME+IR-TR
100	Neotorularia torulosa (Desf.) Hedge & J.Léonard	Brassicaceae	Th	IR-TR
101	Picris albida Ball	Asteraceae	Th	SA
102	Picris babylonica Hand.-Mazz.	Asteraceae	Th	SA
103	Plantago ciliata Desf.	Plantaginaceae	Th	SA-SI + IR-TR
104	Plantago ovata Phil.	Plantaginaceae	Th	IR-TR+SA
105	Pteranthus dichotomus Forssk.	Caryophyllaceae	Th	SA
106	Reichardia tingitana (L.) Roth.	Asteraceae	Th	ME+IR-TR
107	Rumex vesicarius L.	Polygonaceae	Th	SA
108	Schimpera arabica Hochst. & Steud	Brassicaceae	Th	SA
109	Schismus barbatus (L.) Thell.	Poaceae	Th	IR-TR+SA
110	Sclerocephalus arabicus Boiss.	Caryophyllaceae	Th	SA
111	Senecio gallicus Vill.	Asteraceae	Th	IR-TR+SA
112	Senecio potosianus Klatt	Asteraceae	Th	IR-TR+SA
113	Silene arabica Boiss.	Caryophyllaceae	Th	SA
114	Trigonella hamosa Del. ex Smith	Fabaceae	Th	SU
115	Trigonella stellata Forssk.	Fabaceae	Th	SA
116	Urospermum picroides (L.) Scop. ex F.W.Schmidt	Asteraceae	Th	ME+IR-TR

Abbreviations: Med: Mediterranean.

3.3. Plant Life-Forms in the Study Area

The recorded species of the present study are classified under 6 types of life-form according to the Raunkiaer system [16] as follows: therophytes (45.69%) chamaephytes (33.62%), hemicryptophytes (13.79%), phanerophytes

(4.31%), geophytes (1.72) and parasite (0.86) (Figure 3). Therophytes appear to dominate other life forms due to biotic impact, topographic variance, and local climate (annual rainfall) [29]. Therophytes are only numerous during the rainy season and when salinity is not

a limiting factor. They are equally poorly suited to drought and salinity, and their presence is a seasonal phenomenon [30]. The research area's predominant dry environment, water availability, and sandy soil type all contribute to therophytes predominating during the favourable season. Similar results were obtained in different regions of Saudi Arabia such as Mossalam [24] in Taif, and Alatar et al. [25] in AlJufair wadi, Fadl et al. [26] in wadi Elkor, Sarawat Mountain.

The unusually high values of chamaephytes and hemicryptophytes may be explained by the species' resistance to grazing, salt, sand buildup, drought, and other environmental stresses [31,32]. Rhizomatous species make up the majority of the reported cryptophytes, which is advantageous for both their effective development and spread [33]. Phanerophyte, or the visible plants, is the lower life kind. The buds of these plants, which are often woody and perennial, can grow up to 50 cm above the soil's surface.

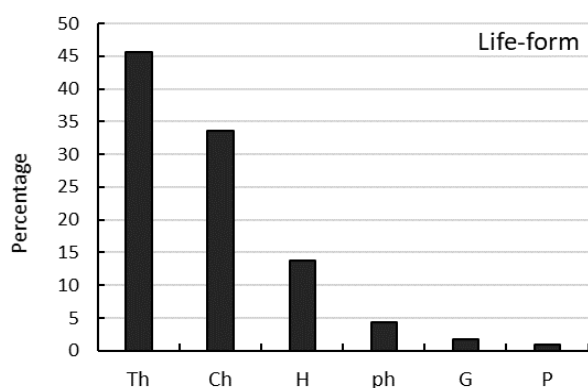


Figure 3. Plant life forms in the study area. Ch: chamaephytes, H: hemicryptophytes, Th: therophytes, Ph: phanerophytes, G: geophytes and P: Parasite

3.4. The Floristic Analysis of the Study Area

Figure 4a indicates the plant families of the species registered in the study area, which are 116 plant species belonging 92 genera and 26 families. The Asteraceae family represents 29 plant species with a percentage of 25% of the total number of plant species, followed by the Brassicaceae family, to which 15 plant species are present in the study area, which amounted to 12.93% of the total number of plant species. The Poaceae family represented by 13 plant species, amounting 11.21% of the total number of plant species in the study area. Then the

Fabaceae family represented by 10 plant species, amounting 8.62% of the total number of plant species in the study area. Caryophyllaceae family represents 8 plant species with a percentage of 6.90% of the total number of plant species, and Zygophyllaceae represented by 5 plant species with a percentage of 4.31% of the total number of plant species. The remaining plant families, which numbered (9 families), they were represented by less than five species.

Figure 4b reveals that the floristic classes of the plant species recorded in the study area, where it is clear that there are (31) plant species of the plants of the Saharo-Arabian, which is a vegetation area covered by hot and semi-desert deserts and savannah and represents about 26.72% of total plant species identified in the study area (Figure 4b). The Saharo-Arabian element comprised pure Saharo-Arabian (mono-regional with 26.72%), bi-regional species with 26.72% and plurioregional species with only species (0.86%). In addition, there are a number of plants that were found in the study area belonging to the Irano-Turanian and Saharo-Arabian, and their number in the study area is 16 plant species, representing about 13.79% of the total plant species that were identified in study area. Saharo-Sindian phytochoria possessed 21 plant species which are pure or conjugation element. As for the number of plants that were found in the study area, they belong to the Iranian-Turanian and Sudanian region. Their number in the study area is 4 and 16 plant species, and they also represent about 3.45% and 13.79% of the whole plant species that were identified in the study area, respectively. Sudan-Zambezians, it is an African region with vast areas of forests, savannas and pasture plants, with flourishing forests and sometimes dry forests, and the number in the study area is 5 plant species (Figure 4b).

According to Moawad [34], the majority of plant species in the Alaqan area in the Tabuk region in northwest Saudi Arabia are from the SaharoArabian, Irano-Turanian and Sudanian regions. In the Khulais area in west Saudi Arabia, Alsherif et al. [35] discovered that Saharo-Arabian and Sudanian components contributed most to the region's overall flora. Similar reports of Saharo-Arbian and Sudanian

components predominating in the southwest Saudi Arabian area of Al Soada [36].

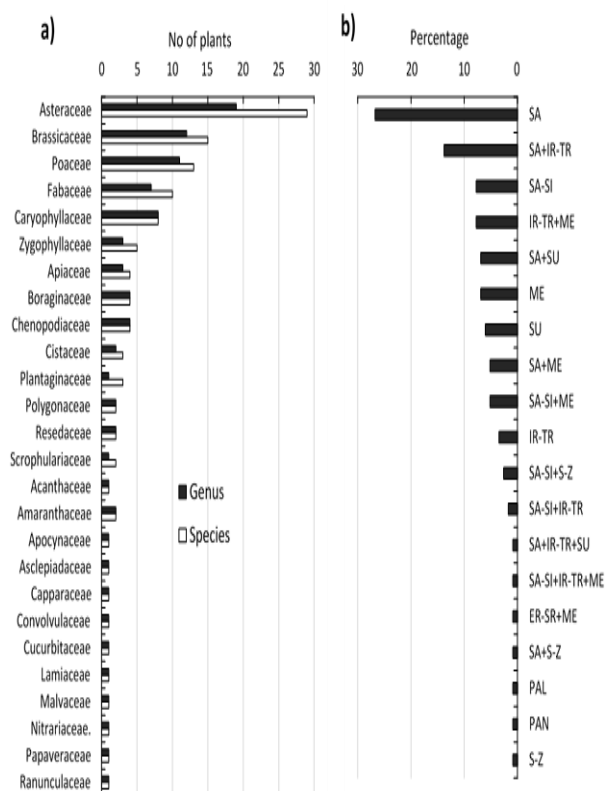


Figure 4. Floristic composition in the study area **a)** Number of genus and species in plant families **b)** Percentage of various phytochorotype.

4. Conclusion

It was determined that the Riyadh Region and the surrounding area have a noteworthy floristic richness as well as a significantly high taxonomic and species diversity. 116 plant species could be found in the research region. However, a number of recent human activities have had an impact on this natural biodiversity hotspot. To preserve the natural variety in this crucial plant region, a conservation effort should be started.

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