INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print), 2222-5234 (Online)
http://www.innspub.net
Vol. 14, No. 2, p. 349-359, 2019

RESEARCH PAPER OPEN ACCESS

Diversity study of the spontaneous flora in Touggourt area (Sahara Septentrional Algerian)

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Key words: Diversity, Spontaneous flora, Biological type, Biogeographical element, Touggourt.

http://dx.doi.org/10.12692/ijb/14.2.349-359 Article published on February 27, 2019

Abstract

The present study was carried out to evaluate the floral diversity of Touggourt area in Sahara Septentrional Algerian. Foursampling sites purposely selected for this study.Using the subjective sampling method using and minimum area field technique.The results revealeda floristic richness of 49 species belonging to 44 genera and 22 botanical families grouped into two monocotyledon and dicotyledon classes, divided into 26 perennials and 23 ephemeral. The families best represented are Amaranthaceae (18.36%) followed equally by Asteraceae and Poaceae (14.28%). The distribution of species remains heterogeneous from one station to another and from one biotope to another. The biological spectrum of species harvested with a predominance of Therophytes (36,71%) and Chamyphetes (30,61%), a predominance that denotes a semiarid and arid climate. Biogeographically, saharo-Indian binding species are best presented with (42.85%) followed by endemic species (22.44%) indicating that Touggourt is a predominantly Saharo-Indian and endemic phytogeographic aera.the preservation of this short-term exceptional biodiversity requires the urgent establishment of scientific studies and appropriate safeguards.

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Introduction

Knowledge, classification, characterisation and conservation of different taxa is a global scientific priority for the assessment and management of biodiversity (Cotterill, 1995). The efforts made to study flora are very important in order to know the major biological features of plants and their biogeographical distribution (Lavergne *et al*., 2005). However, many aspects of a considerable number of plant species remain unknown in some respects: biological, taxonomic and ecological (Grubb, 1977; Pyšek *et al*., 2008).

Most species of spontaneous flora, particularly in North Africa, are remarkably resistant and well adapted to drought and salinity, and constitute a significant proportion of local genetic resources with pastoral, forage, food, aromatic and medicinal values (Abdelguerfi and Laouar,1999 ; Ohba and Amirouche, 2003).

The Sahara, which occupies 10% of the surface of the African continent, is the largest hot desert in the world (Rognon, 1994). Despite its vast scope, cash wealth and endemism are low. Although some acclimated species survive with extraordinary forms of adaptation (Le Houérou, 2001).

This ecoregion includes the northern part of the Sahara, where precipitation occurs during the winter, feeding a variety of plants that bloom before the hot and dry summer; in general, ecological conditions in these areas are very restrictive to the spontaneous survival of living things (Chenchouni, 2012).

The Sahara flora is very remarkable for its adaptation to a dry climate and to a low salt soil (Trabut and Mares, 1906). It appears to be very poor, compared to the small number of species that inhabit it; to the enormity of the surface it covers. It comprises only 1200 species (Ozenda, 1991).

Little work has been done on the knowledge of the floristic biodiversity of the northern Sahara region, and in particular that of Oued Righ. Nevertheless, studies carried out on the description of the Saharan flora in general (Quezel and Santa, 1962 and 1963; Ozenda, 1978 ; Trabut and Mares, 1906),and that of the northern Sahara in particular (Ozenda,1958 ; Chehma, 1995 ;Baameur, 2006; Khouda and Hammou, 2006 ;Chehma, 2006;Halis *et al*., 2012;Medjber, 2014; Chenchouni, 2012; Hadjaidji and Derridj, 2013; Koull and Chehma, 2014; Mouane *et al*., 2017).

The vegetation of this biome is still worth studying given the scarcity of species and their extraordinary phenologies. This same work, which remains punctual and localized, signals the presence of a fairly rich biodiversity and especially original for the region. It is in this perspective that it will be necessary to study the floristic, biological and phytogeographic diversity of the Touggourt aera.

Materials and methods

Selected stations

4 representative stations in the Touggourt area, are selected using the Gounot method (1969)(Fig .1), station selection criteria are based on the most discriminatory ecological factors of vegetation, including geomorphology and soil. Station1 between Touggourt and El Hadjira (32°41'25. 81'N, 5°50'38. 58" E), stands at an elevation of 103 m at about 50 km from Touggourt, station 2 between Touggourt and Djamaa (33°24'02. 35'N, 5°58'37.73'E), located at an elevation of 58 to about 40 km from Touggourt. Station 3 between Touggourt and Taibet (33°06'49. 43" N, 6°23'08. 75" E), located at an elevation of 109 m approximately 30 km from Touggourt. And station 4 on the road between Touggourt and Messaad (33°09'26. 09" N5°31'34.94" E), located at an altitude of 146m about 50 km from Touggourt.

Floristic data

Counting plants through reasoned sampling is the simplest and most intuitive method. For the sampling period, spring is chosen because it is the season where development and floristic diversity are maximum, particularly for annual species (Ozenda, 1978); takes into account the vitality and health of plants, but also

environmental conditions.

After the establishment of a herbarium, species identification is done with the flora of Ozenda (1991), the biogeographical element was determined with Quezel and Santa (1963) and Ozenda (1991). The life forms were determined according to the Raunkiaer classification (1934).

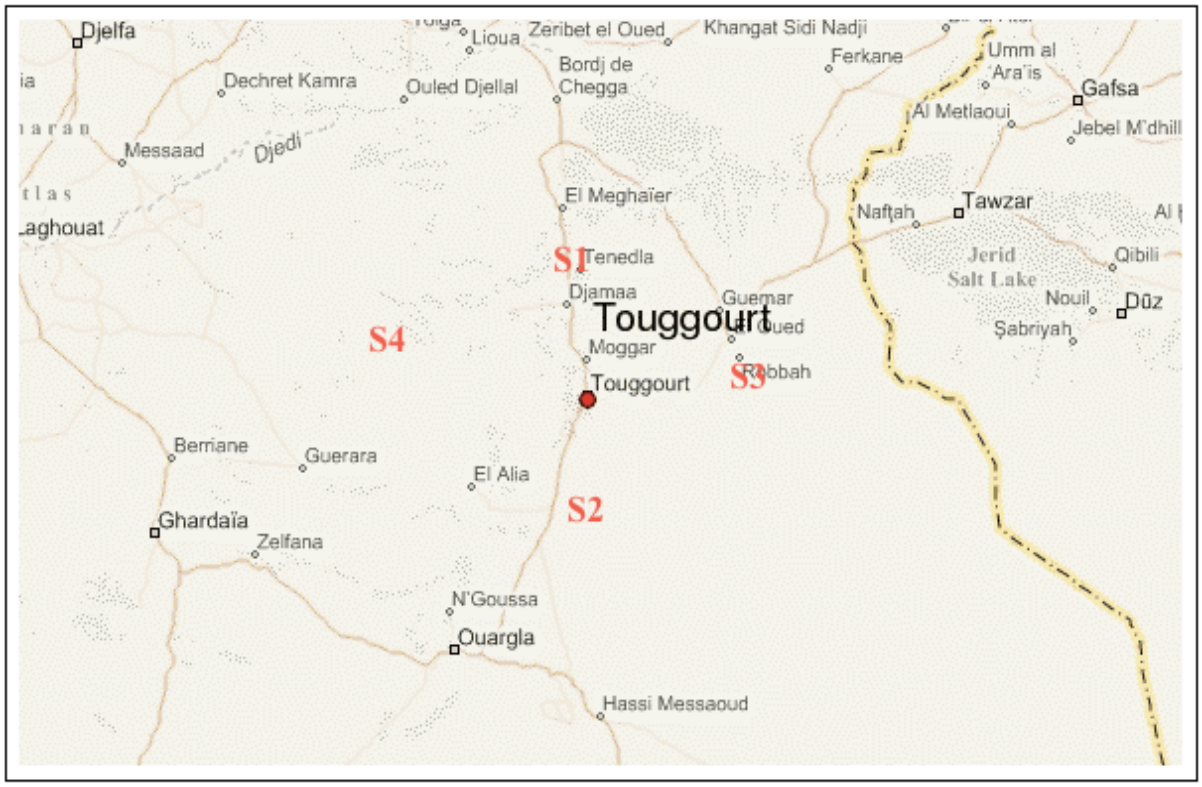


Fig. 1. Location of study stations in the Touggourt area.

Results and discussion

Floristic data in study area

Subjective sampling of 4 stations in the Touggourt area revealed the existence of 49 species, divided into 44 genera and 22 botanical families grouped into two monocotyledon and dicotyledon classes, 13 of which are represented by only one species, or 26.53% of the overall population, Baameur (2006). According to various floristic surveys, different geomorphological forms in the Ouargla region have identified 56 species belonging to 28 families. Mouane *et al.*, (2017) identified 64 plant grouped into 23 families which 20 are medicinalin the same region, While Chehma (1995) reports only 29 species in the Ghardaïa aera. Medjber (2014) reports the presence of 62 species in 23 botanical families in the souff region, Hajaidji and Derridj (2014) notes the presence of 64 species spread between 43 spontaneous and 22 cultivation in the Touggourt and Ouargla aera. While Halis *et al.*, (2012) single out the presence of 38 species spread over 13 families in the dirty soils of the Oued Righ Valley, while Houerou (1995) notes 2630 in the arid areas of North Africa. In Sahara, 1200 species are inventoried, of which only 500 are inventoried by Ozenda (1991), in northern Sahara. It should be noted that in the study area, the natural environment is currently deteriorating due mainly to climate change, overgrazing and poor management of plant genetic resources.

According to the figure 2, the best represented botanical families are those of Amaranthaceae with 09 species or 18.36% of the total population of the latter, They have an adaptation to the conditions of the environment (Le Houerou, 1992), which allows them to occupy more or less extensive territories, followed by Asteraceae and Poaceae who arrive with 7 species for each of them, or 14.28%. Moreover,

Boraginaceae, with 3 species represented, or 6.12%. For Brassicaceae, Caryophylllaceae, Fae, Tamariceae, and Tamariceae, and Zygophyllaceae, or only 2%. These families are the most encountered in the Mediterranean flora of North Africa (Ozenda , 1978). Ozenda (1991), notes that grasses (Poaceae), legumes (Fabaceae) and compounds (Asteraceae), are the predominant families in all locations, including the southern portion.

Table 1. Floristic list with families and classes of inventory species, biological types; A.: Annual, V.: Vivacious; phytogeographic type; SS: Saharo-sindian, END: endemic, COS: cosmopolitan, MED: Mediterranean, SM: Saharo-Mediterranean, MSS: Mediterranean-Saharo-sindian; biological forme; CHA: Chaemaephyte, CRY: Cryptophyte, HEM: Hemicryptophyte, PHA: Phanerophyte, THE: Therophyte

Classes	Familles	Species	Stations								Biological type		Phytogeographic type	Biological forme
			S1		S2		S3		S4		A .	V.		
			A.	V.	A.	V.	A.	V.	A.	V.				
Monocotyledone	Poaceae	*Cynodon dactylon (L.) Pers.*						X				X	COS	CRY
		Panicum turgidum Forsk.					X				X		SS	THE
		Phalaris minor Retz.	X								X		COS	THE
		Phragmites communis Trin.				X						X	COS	CRY
		Stipagrostis obtusa Del.					X				X		END	THE
		Stipagrostis plumosa L.								X		X	SS	THE
		Stipagrostis pungens Desf.						X				X	SA	CRY
Dicotyledone	Amaranthaceae	*Agathophora alopecuroides (Del.)Fenzl.*	X									X	SS	CHA
		Anabasis articulata Moq.				X						X	SS	CHA
		Atriplex halimus L.				X						X	COS	CHA
		Cornulaca monacantha Del.						X				X	SS	CHA
		Halocnemum strobilaceum (Pall.)Marsch.				X						X	MED	HEM
		Haloxylon articulatum Boiss.								X		X	MED	CHA
		Salsola baryosma (Schult.) Dandy						X				X	SS	CHA
		Salsola tetragona Del.								X		X	SM	CHA
		Traganum nudatum Del.								X		X	SS	CHA
	Apiaceae	*Ammodaucus leucotrichus Coss.et Dur.*							X		X		END	THE
	Asteraceae	*Anacyclus cyrtolepidioides Pomel.*	X								X		END	THE
		Atractylis serratuloides Sieber.		X								X	SS	THE
		Catananche arenaria Cosson et DR							X		X		END	THE
		Ifloga spicata (Vahl.) C.H.Schultz	X		X				X		X		SS	PHA
		Launaea glomerata (Cass.)Hook.							X		X		SS	THE
		Launaea mucronata (Forsk.)Muschler.					X				X		MED	HEM
		Sonchus maritimus L.		X								X	COS	CRY
	Boraginaceae	*Echium humile (Desf.) Jah.*	X		X				X		X		END	THE
		Megastoma pusillum Coss. et Dur.					X				X		END	THE
		Moltkia ciliata (Forsk.)	X								X		SS	CHA
	Brassicaceae	*Malcomia aegyptiac Spr.*					X				X		SS	THE
		Oudneya africana R.Br.		X								X	END	CHA
	Capparidaceae	*Cleome Arabica L.*						X				X	END	THE
	Caryophyllaceae	*Pteranthus chloranthus Forssk .*					X				X		MSS	CHA
		Paronychia argentea Lamek.		X								X	MED	HEM
	Cistaceae	*Helianthemum lippii (L.)Pers.*					X				X		SS	CHA
	Euphorbiaceae	*Euphorbia guyoniana Boss .et Remt*						X				X	END	HEM
	Fabaceae	*Astragalus mareoticus Del.*	X		X						X		SS	THE
		Retama retam Webb.						X				X	SS	CHA
	Geraniaceae	*Erodium glaucophyllum L'Her*	X								X		SM	HEM
	Juncaceae	*Juncus rigidus Desf.*		X								X	COS	HEM

	Malvaceae	*Malva aegyptiaca L.*	X							X		MED	CHA
	Orobanchaceae	*Cistanche tinctoria (Desf.)Beck*	X							X		SM	PHA
	Plantaginaceae	*Plantago ciliata Desf.*	X			X				X		SS	THE
	Plombaginaceae	*Limoniastrum guyonianum Dur.*		X							X	END	PHA
	Polugonaceae	*Emex spinosa Camp.*	X							X		SA	THE
	Resedaceae	*Reseda villosa Coss.*		X							X	END	PHA
	Rosaceae	*Neurada procumbens L.*	X							X		SS	THE
	Tamaricaceae	*Tamarix articulata Vahl*					X				X	SS	PHA
		Tamarix gallica L.		X		X					X	SS	PHA
	Zygophyllaceae	*Fagonia glutinosa Del.*	X							X		SS	THE
		Zygophyllum album L.		X		X					X	SS	CHA
Total	22	49	14	9	3	6	8	7	5	4	23	26		
Fréquency		100%	46,93		22,44		30,61		16,32		46,93	53,06		

Considering the temporal distribution of this spontaneous flora, on 49 listedspecies, 46,93 % are short-lived and 53,02 % of the long-lived. During the various exits in ground, herbs or " achebs " are more plentiful than trees, shrubs or bushes. The table (1) lets appear 26 perennials and 23 annual plants. To Amaranthaceae, meet more perennials. In this family, on 09 collected(harvested) plants, 08 are long-lived species. They are species such as *Anabasis articulata, Atriplex halimus, Halocnemum strobilaceum, Haloxylon articulatum, Salsola baryosma, Salsola tetragona, Traganum nudatum*. Some families as Brassicaceae *(Oudneya africana),* Caryophyllaceae (*Paronychia argentea),* Euphorbiaceae *(Euphorbia guyoniana,*Juncaceae (*Juncus rigidus),* Plombaginaceae *(Limoniastrum guyonianum),* Resedaceae *(Reseda villosa*) and Zygophyllaceae *(Zygophyllum album*) contain only one perennial species. According to UNESCO (1960), herbs only appear for a short period of the year, when conditions become favourable, while perennials show morphological changes that allow them to withstand moisture insufficiency and long periods of drought. Monod (1973) notes that the appearance of ephemerals is rapid, almost brutal, as soon as it rains; the soil is covered with seedlings that have no morphological adaptation to drought. However, the uneven distribution between ephemerals and perennials is also due to adaptation to drought (Ozenda, 1991).

Floristic data of study stations

The results of enumeration of the floristic procession of the four study stations show that station 1, is the most supplied in spontaneous plant species. It is home to 23 species representing 46.93% of the global flora grouped into 18 families. Fifteen of them are represented by a single species (4,34 %). Other families, including Asteraceae (17.39%), are represented by the association of *Anacyclus Cyrtolepidioides, Atractylis serratuloides, Ifloga spicata and Sonchus maritimus;* Boraginaceae (8,69 %), as well as by the association of *Echium humile* and *Megastoma pusillum*; the Zygophyllaceae (8,69 %), and finally the association of *Fagonia glutinosa* and *Zygophllum album*. With a total of 39.13% perennial versus 60.86% ephemeral.They are ephemeral species capable of growing and blooming rapidly, covering the soil for short periods (Mackenzie *et al*., 2000).

The 15 species of station 3, surveyed between Touggourt and Taibet, account for 30,61 % of the total flora. They are divided into 12 families including: Asteraceae, Boraginaceae, Brassicaceae, Capparidaceae, Caryophyllaceae, Cistaceae, Euphorbiaceae, Fabaceae, Plantaginaceae and Tamaricaceae, represented by a single species, representing 6.66% of the total number of families. Then, respectively, the Poaceae family with 26,6 % by the association of the *Cynodon dactylon, Panicum turgidum, Stipagrostis obtusa and Stipagrostis pungens,* then that of the Amaranthaceae with 13,33 % by the association of *Cornulaca monacantha and salsola baryosma.* , With a total of 53.33% perennial versus 46.66% ephemeral.These perennial plants are always available regardless of weather conditions. These values confirm the results obtained in other

works on the use of medicinal plants (Chehma and Djebar, 2008).

Regarding station 02, between Touggourt and Djamaa, it is home to 9 species representing 18,36 of the total flora. They are divided into 08 families including Amaranthaceae with 27,27 % by the association of *Anabasis articulata, atriplex halimus and Halocnemum strobilaceum*. The other families are mainly represented by *Phragmites communis* (Poaceae), *Ifloga spicata* (Asteraceae), *Echium humile* (Boraginaceae), *Astragalus mareoticus* (Fabaceae), *Tamarix Gallica* (Tamaricaceae) and *Zygophyllum albu*m (Zygophylllaceae).

These different species account for 66,66% perennial plants, compared with 33,33% ephemeral plants (Table 1). According to Viennot- Bourgin (1960); the flora of the saline grounds always poor and is characterized by the prevalence of the specialized species (halophytes) belonging mainly to the family of Amaranthaceae.

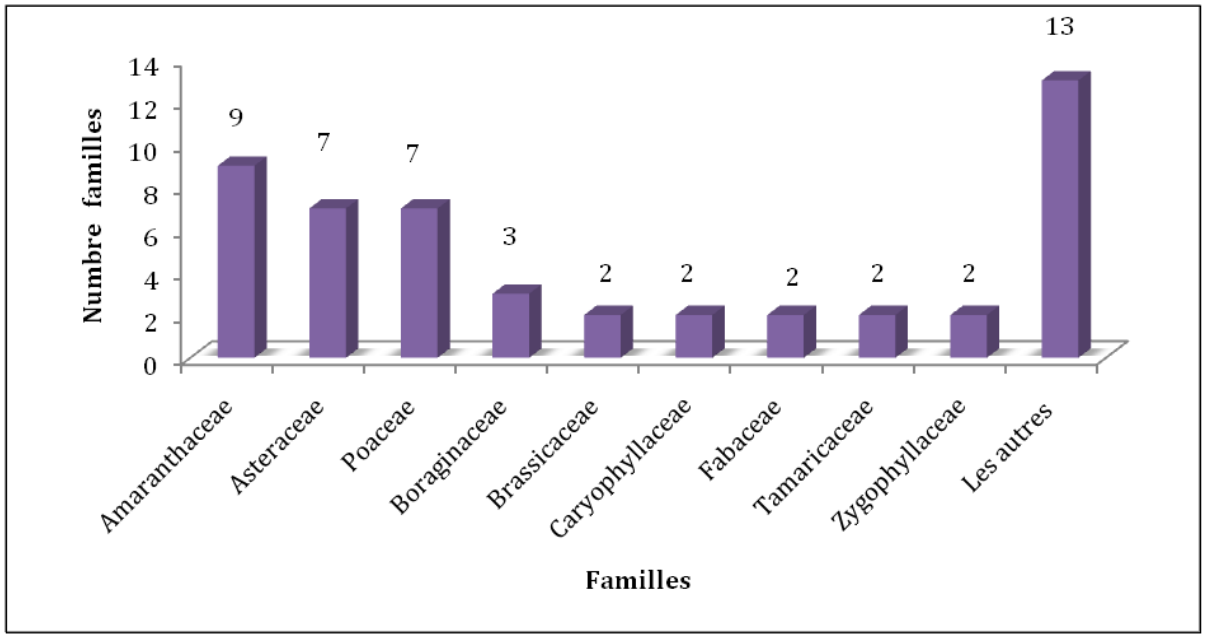


Fig. 2. Number of species by family in the study area.

For station 4, between Touggourt and Messaad, 9 plant species or 18,36 % of the total inventory represented by 05 families are sampled. The Amaranthaceae and Asteraceae are at the top of the list with 37.5% each, Amaranthaceae by the association of *haloxylon articulatum*, *salsola tetragona* and *Traganum nudatum* and Asteraceae *by the association of Catananche arenaria, Ifloga spicata and* Launaea glomerata. Three families are represented by a single species, 12.5% each: Apiacae by *Ammodaucus leucotricus*, Boraginaceae by *Echium humile* and Peaceae by *Stipagrostis plumosa*. At this station, the annual plants lead the way with 55.55% and perennials only represent 44.44%.According to Chehma (2006);In northern Sahara, Despite the Harsh and very restrictive environmental conditions, there are still geomorphological zones that offer more or less favourable conditions for the survival and proliferation of a spontaneous Sahara Flora Characteristic and adapted to the Climatic Hazards of this desert environment. Outside of these areas, there is no vegetation cover.

The distribution of vegetation remains heterogeneous from one station to another and from one biotope to another. The distributions are made according to the characteristics of the different biotopes and the different forms of adaptation of plant species in our stations. Installation of the Saharan vegetation mat is intimately linked to soil geomorphology, physical-chemical characteristics and water refueling, which

may be favourable or unfavourable to the development of different species, assuming climate differences from one location to another in a very small region (Ozenda, 1958 ; Guinochet, 1973).

For the biological spectrum, Therophytes are best represented with 18 species, an overall rate of 36.71%, followed by Chamephytes with 15 species (30.61%), then also hemi-cryptophytes and Phanerophytes with 6 species (12.24%) and finally, cryptophytes with 4 species (8.16%)(Fig.3).

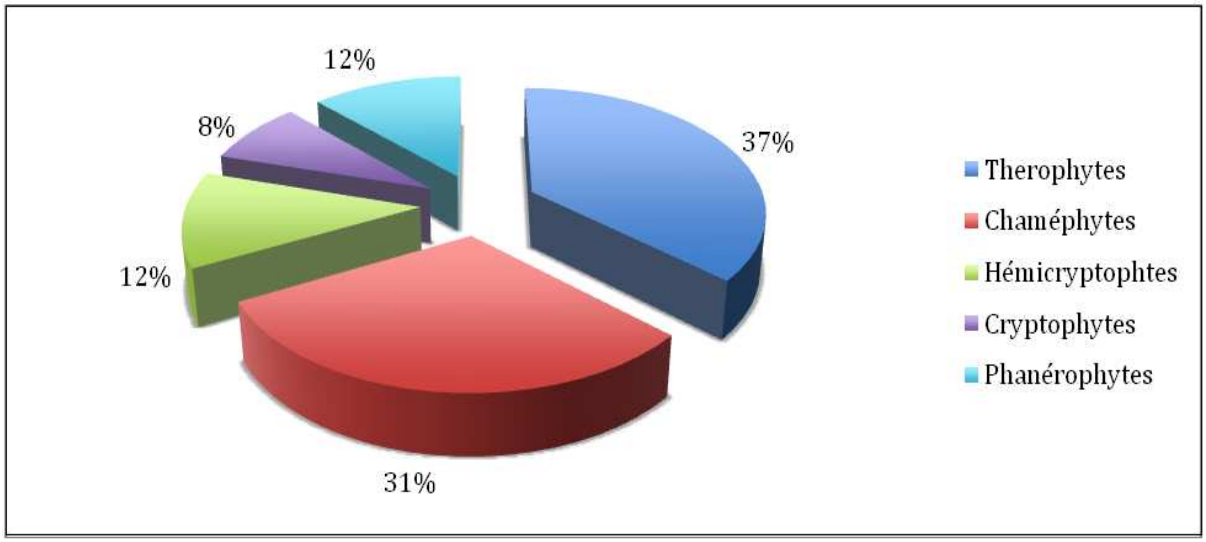


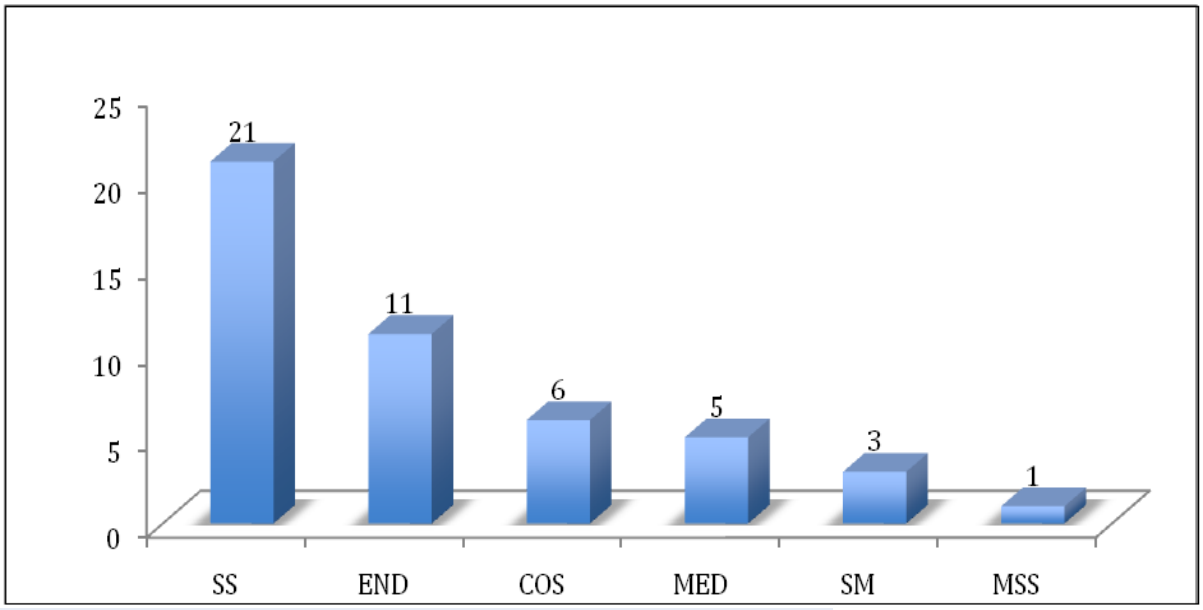
Fig. 3. Biological spectra of spontaneous flora in the study area.

This therophytisation represents the ultimate stage of degradation of xeric habitats, and is often linked to environmental disturbances by grazing (Quezel, 2000), according to Lacoste and Salanon (2001), in arid and semi-arid Mediterranean areas, Therophytes dominate. According to Gomaa (2012) this class of plant has low ecological requirements, they colonize various types of environments, for Aidoud Chamephytes (2005) notes that they have good adaptation to drought, also El-Bana *andal.,* (2002), reports that the high percentage of Chamaephytes may be related to their ability to withstand drought and salinity. Regarding the rarity of the Phanerophytes, Ozenda (1964) reports that the tree strata of the arid zone is very disseminated and dispersed in space. Monod (1973), notes that the common character of all deserts is the scarcity of trees (Fig. 3). This variation was, however, directly related to the plant cycle and the mode of adaptation of desert species (Ozenda, 1991), which depends on climatic conditions (Gardi, 1973; Poupon, 1980). Identifying the biological spectrum of vegetation reveals the relationships that highlight the dependencies between biological type distribution and environmental factors (Ellenberg and Mueller-Dombois , 1967; Floret *et al.*, 1990).

Nevertheless, the global phytogeographic spectrum (Fig. 4) show a diversity of phytogeographic elements with the dominance of the element Saharo-Sindien,

With 22 species, or (42,85 %). This element occupies a preponderant place in the flora of northern Sahara (Ozenda, 1991); it is due to the fact that the zone of study is in Algerian Sahara, which is a part of the region phytogeographic saharo-sindienne (Zohary, 1973). Followed by 22 endemic species or 22, 44 %, followed by 6 cosmopolitan species or (12,24 %).

According to Quezel (1978), the endemism is raised to it because of the vast species unfit for life, for northern Sahara, 162 endemic species are count The element Mediterranean represent by 5 species *Halocnemum strobilaceum, Haloxylon articulatum, Launaea mucronata, Pteranthus chloranthus, Malva aegyptiaca* is (10,24%).



SS: Saharo-sindian, END: endemic, COS: cosmopolitan, MED: Mediterranean,
SM: Saharo-Mediterranean, MSS: Mediterranean-Saharo-sindian.

Fig. 4. The phytogeographic spectrum of the study area.

The other elements are poorly represented. According to Quezel (1978), the flora of Mediterranean Africa is phytogeographically diverse following climatic changes since the Miocene, which has caused the migration of tropical flora (Quezel, 1983), This flora is currently adapted to the conditions of the Saharan regions. Phytogeographical relationships have a significant influence on species diversity as they largely determine the stock of species available in the past and present to inhabit the region (Abdel-wahab Rh *et al.*, 2008).

Conclusion

The spontaneous flora in this part of the Northern Sahara is very diverse.This study allowed to evaluate the floristic richness of the Touggourt area. It shows that the most dominant families are those of Amarantaceae, Poaceae and Asteraceae with different distributions according to the stations. The best represented biological types are Therophytes and Chamephytes. Analysis of the phytogeographic spectrum shows that the Saharo-Indian element and endemic is most represented.This study contributes to a better knowledge of the flora of the Touggourt region, it is important to multiply the research on the phytoecological aspect of Spontaneous plants on all The region.

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