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Original Research

Significance of fallow on rangelands rehabilitation in an arid area from Central Algeria

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ABSTRACT:

The crops introduction under pivot in arid zones has induced changes in the soil and natural vegetation. After fallowing or abandoning of these plots, a new spontaneous flora generally originating settles. Our work consists of studying the importance of fallowing on rangeland rehabilitation in the Ghardaia region (Algerian Center). For this, we selected 3 stations at different ages of abandonment in the region of Hassi El Fehal (Ghardaia) potentially producing region cereals: a reference station has never been cultivated and two other stations abandoned respectively from one and 04 years after having been exploited for five years in a cereal under pivot. Sampling allowed us to inventory 25 species distributed over 16 botanical families. Correspondence factor analysis applied to three stations revealed that the recently abandoned station represents a great diversity of flora (17 species) relative to the other two stations (11 each species), which is probably related to depletion of the seed bank thus reducing following species. It is noted that the species *Linaria aegyptiaca* exist after four unplanted years, and two species: *Colocynthis vulgaris* and *Pergularia tomentosa* appear after fallow; This probably indicates a return to the original state of rangelands (indicator species of the return to the natural environment). But *Fagonia microphyl*la, classified as a species of Hamada (rangelands) was not influenced by neither the cultivation nor the fallow (abandoned).

Keywords:

Fallow, Rangelands, Vegetation, Arid area, Central Algeria.

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INTRODUCTION

Agriculture is the most dominant form of land use in the world (Haripal *et al.*, 2016). But the abandonment of agricultural land is also spreading increasingly (Alcantara *et al.*, 2012). In Algeria, specifically in arid area, agriculture is a very tough challenge due to soil and climate parameters. The typical example is that of the cereal crop in the Algerian Sahara with the aim of developing the economy of these regions and reduce chronic dependence on the cereals of the country (Otmane and Kouzmine, 2013). The introduction of such an annual intensive production culture on large areas with significant capital (Abadie, 2003; Frenken, 2005) in arid areas can induce changes on soil (Benbrahim *et al.*, 2016) and it's natural vegetation. It is noted that most cereal perimeters, if not all, are initially installed on rangelands (Brahim, 2009). Which are very rich in spontaneous species and are the natural reservoirs of the Saharan flora and especially the endemic one (Chehma, 2005; 2006).

The degradation of soil and water quality due to mechanized tillage and chemical inputs, causes the decline of untargeted species due to inappropriate pesticides application (McLaughlin and Mineau, 1995; Foley *et al.*, 2005). This reduced soil fertility and destabilized the agro-ecosystem. Very often, these lands will be abandoned by farmers (Haripal *et al.*, 2016). After the fallow or the abandonment of these rangelands, a new flora is introduced. This is, in ecology, called successive replacement of species over time (Lepart and Escarré 1983). Indeed, some pioneer species rapidly colonize bare soil left after culture; so-called intermediate species develop gradually and are then are ousted by the competition. When pioneer species disappear; late successional species dominate later (Martineau, 2004).

Thus, fallow is one of the solutions of soil rest where the post-cultural dynamics described as secondary succession tend to return these ecosystems to their natural state (Clements, 1916). In this context, our work's goal is to know the importance of fallow on rangeland rehabilitation and arid ecosystem native flora regeneration in Ghardaïa region - Algerian center. Based on the flora survey before and after the agriculture installation. We have selected three stations in the cereal region of Hassi El-fehal Ghardaïa, namely: a natural station (reference) and two other stations with different age of abandonment: a little abandoned (1 year) and the other abandoned (04 years).

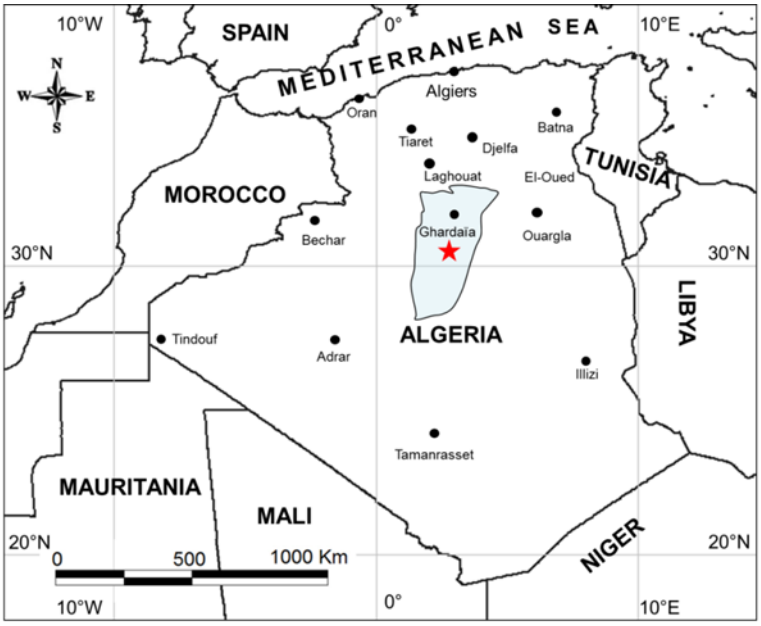

Figure 1. Location of the area Ghardaïa- Algeria

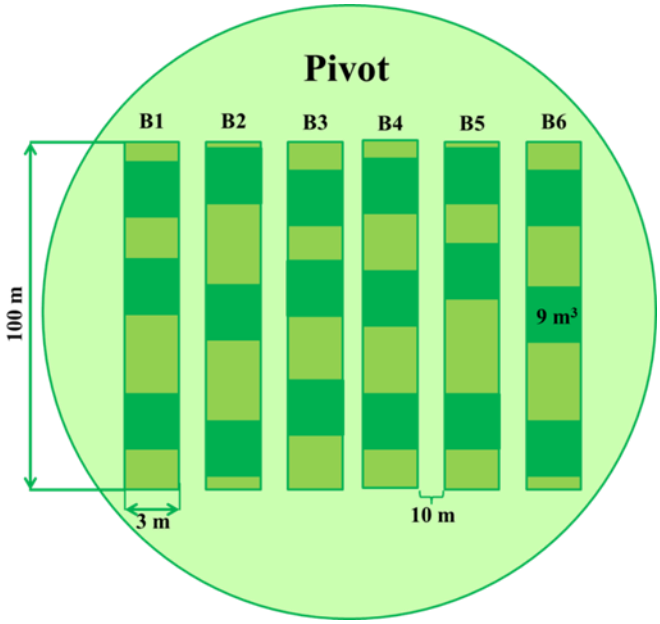

Figure 2. Schematic of sampling plan in a pivot

MATERIALS AND METHODS

Ecology of the study area

The Ghardaïa region is located at the center of the Algerian Figure 1 at a mean altitude of 520 m. This region covers an area of 86,560 km² with geomorphological characteristics comprise wadi and regs. (Benkenzou *et al.*, 2007). The Ghardaïa region is characterized by an arid Saharan climate, which is characterized by high thermal amplitude between day and night, summer and winter (Sam, 2012). January is the coldest with a minimum temperature of 6.2°C, while the hottest month is July, with a maximum temperature of 41.8°C. Rainfall is extremely low in the Ghardaïa region, with an annual total of 80.2 mm per year. The relative humidity of the air in the area is also very low, the atmosphere present almost permanently a moisture deficit. The maximum value of 55.57% in December and minimum of 21.64% in July. Analysis of dry periods over several years showed that the drought is spread almost throughout the year, from February to December and mild wet period occupies January (Sadine *et al*., 2016).

Sampling

To know the influence of the introduction of intensive farming on the structure and dynamics of arid rangeland spontaneous flora, we chose subjectively three stations in the cereal region of Hassi El-fehal Ghardaïa: a reference station (1) that has never been cultivated and two other fallowed stations, one for 01 years and the other for 04 years, after having been operated for 05 consecutive years as a cereal under pivot. Bands of 3 m wide and 100 m long in parallel transects form on the studied surface are chosen systematically. Thus, in each band we realized three random samples of a square of nine m² along the length of the band (Figure 2).

Plant identification

The plants sampled are identified at the botanical laboratory of Ghardaïa's University. Taxa are identified based on Quezel and Santa keys (1962) and Ozenda's Keys (1983 and 2004). For classification according to biological types, we referred to the classification of Raunkiaer (1934) based on the position of buds renovation.

Operations results

To find the interrelations between the composition and structure of spontaneous flora and abandonment duration of plots, qualitative multivariate analysis,

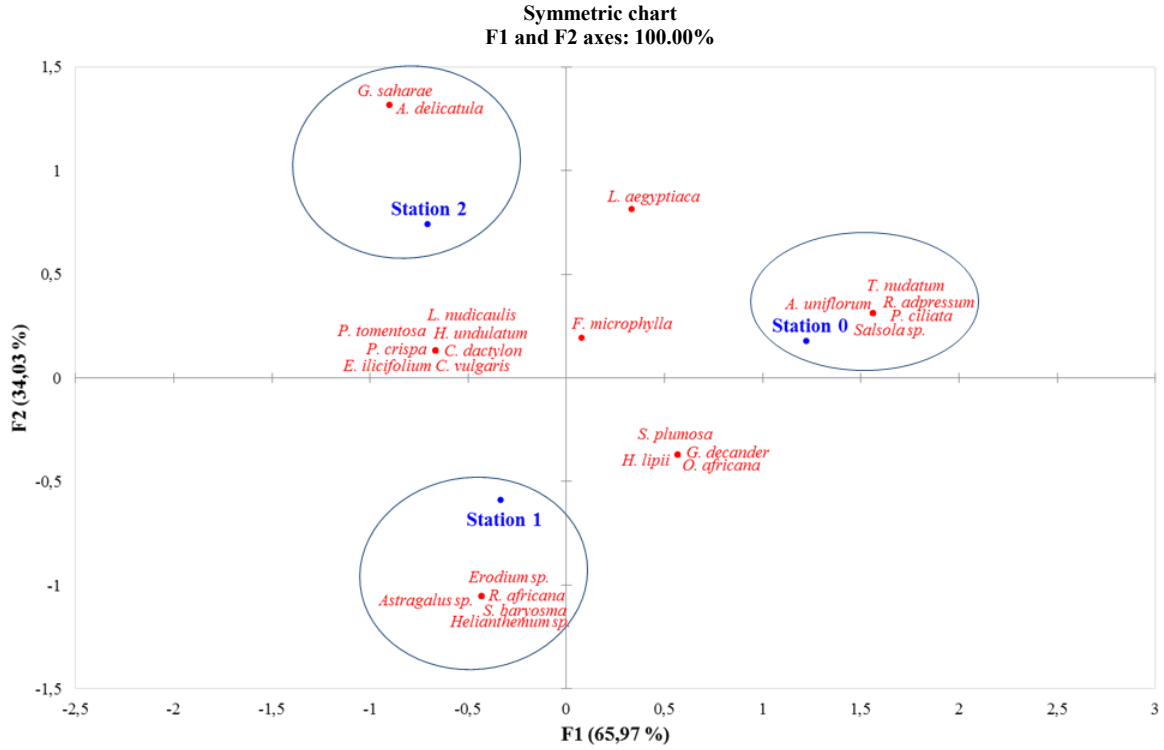

Figure 3. Correspondence factor analysis applied to the three stations

namely the Correspondence Factor Analysis (CFA) was adopted.

RESULTS AND DISCUSSION

The results obtained in this work are shown in a list which includes all species recorded in the three studied sites.

Total flora surveyed in the three stations

The flora inventory in the three studied stations revealed the presence of 25 species spread over 16 botanical families. The list of these species is summarized with common names in the Table 1 which shows 25 inventoried species. The dominance of Asteraceae is well marked with four species, followed by Fabaceae and Chenopodiaceae represented by three species each. Poaceae and Cistaceae are represented by two species each. The rest of the families are represented by a single species each. According to the biological types, it is noted that 72% of the surveyed species are therophytes and chamaephytes. The dominance of these two biological types reflects the adequacy of environmental conditions. Lacoste and Salanon (2001), reported that inthe arid and semi-arid Mediterranean regions, therophytes dominate. Hemicryptophytes, geophytes and phanerophytes are weakly represented with the percentages of 16%, 8% and 4% respectively. These are the types most demanding in terms of climate and soil conditions (Olivereau, 1996; Jauzein, 2011).

Distribution according to the stations

Figure 3 shows that five spontaneous species or rangeland are associated with the reference station (not cultivated station), are either halophytic perennial species, like *Salsola* sp or species resistant to drought such as *Traganum nudatum* (Bahrain and Hashim, 2000; Correra, 2006; Acherkouk *et al.*, 2011; Marei and El-Ghani, 2006). In addition, most species surveyed in this study station are therophytes or chamaephytes. Abderrahmane (2013) noted that *Rhanterium adpressum* sp, *Salsola* sp, *Traganum nudatum*, *Argyrolobium uniflorum* and

Table 1. Structure of the total spontaneous flora

S. No	Family	Species	Vernacular name	Biological Types
1	Apiaceae	*Eryngium ilicifolium* (Lam.)	/	Thérophytes
2	Asclepiadaceae	*Pergularia tomentosa* L.	Kalga	Chaméphytes
3	Asteraceae	*Atractylis delicatula* Batt. Ex L. Chevall.	Sagleghrab	Chaméphytes
		Launaea nudicaulis Hook. f.	Reghime sahraoui	Hémicrypto-phytes
		Pulicaria crispa (Forssk.) Benth. & Hook. f. ex Oliv. & Hiern	Tanetfirt	Chaméphytes
		Rhanterium adpressum Coss. & Durieu	Arfage	Hémicrypto-phytes
4	Boraginaceae	*Heliotropium undulatum* Vahl.	M'deb	Thérophytes
5	Brassicaceae	*Oudneya africana* R. Br.	Henat l'ibel	Géophytes
6	Caryophyllaceae	*Gymnocarpus decander* Forssk.	Djefna	Chaméphytes
7	Chenopodiaceae	*Salsola baryosma* (Schult.) Dandy	Djell	Chaméphytes
		Salsola sp	/	Chaméphytes
		Traganum nudatum Delile	Damrane	Chaméphytes
8	Cistaceae	*Helianthemum lippii* (L.) Dum.Cours.	Rguig	Thérophytes
		Helianthemum sp	/	Thérophytes
9	Cucurbitaceae	*Colocynthis vulgaris* (L.) Schard.	Hadja	Thérophytes
10	Fabaceae	*Argyrolobium uniflorum* (Decne.) Jaub. and Spach	Rguigabelgroun	Hémicrypto-phytes
		Astragalus sp	/	Thérophytes
		Genista saharae Coss. &Durieu	Merkh	Phanérophytes
11	Geraniaceae	*Erodium* sp	/	Thérophytes
12	Plantaginaceae	*Plantago ciliata* Desf.	Lalma	Thérophytes
13	Poaceae	*Cynodon dactylon* (L.) Pers.	Nedjeme	Géophytes
		Stipagrostis plumosa (L.) Munro ex T. Anderson	N'sie	Hémicrypto-phytes
14	Resedaceae	*Randonia africana* Coss.	Godm	Chaméphytes
15	Scrophularia-ceae	*Linaria aegyptiaca* (L.) Dum.Cours.	/	Thérophytes
16	Zygophyllaceae	*Fagonia microphylla* Pomel	Desma	Chaméphytes

Plantago ciliata are sp that settle and develop only in non-anthropized environments.

The second station is found with *Salsola baryosma*, *Helianthemum* sp, *Astragalus* sp, *Erodium* sp and *Randonia africana* which are pioneer species (Quezel and Santa, 1962; Ozenda, 1977) and indicator of environmental degradation (Saoudi, 2007). It should also be noted that the *Erodium* sp an annual gypsophila plant (Benaradj *et al.*, 2012), develops during the first year of post-culture, probably after a precipitation period. The station 3 is isolated with two species *Atractylis delicatula* classified as weed and *Genista saharae* shrub species developed in Ergs or in sanded environment (Ozenda, 1977).

A group of plants are common to both cultivated stations, dominated by messicolous plants namely

Launaea nudicaulis Adam (1962) although reported as natural flora (Guinet and Savage, 1954; Ozenda, 2004) and other weeds were associated with cereals such as *Cynodon dactylon*. *Colocynthis vulgaris* and *Pergularia tomentosa* are more frequent in the rangelands of Hamada and tolerant harsh soil and climatic conditions of Sahara (Chehma, 2005; 2006), their presence in the two stations after a fallow period also indicates the return of these two stations to the initial state (Hamada).

Low rehabilitation is probably due to a depletion of the seed bank thereby decreasing following species (Bekker *et al*., 1996; Bakker and Berendse, 1999), or at another crucial constraint is that the persistence of competitive species of weeds that could prevent the vegetation development over several years (Burch, 1996; Hansson and Fogelfors 1998). It is also found that in this spaces, the flora is vulnerable but it is characterized by certain plasticity; some original and specific plants of Hamadas or Regs like *Fagonia microphylla* were retained and not influenced by the cultivation or fallowing (abandoned).

CONCLUSION

After this research, we noticed that following the degradation of rangelands after years of exploitation as agricultural lands, an installation of indicator pioneer species of land degradation are: *Salsola baryosma*, *Helianthemum* sp, *Astragalus* sp, *Erodium* sp and *Randonia africana* is reported, but these species disappear after a few years of time. During this succession, species such as *Linaria aegyptiaca*, *Colocynthis vulgaris* and *Pergularia tomentosa* reappear during the fallow period and probably indicating a return to the original state of the land. Knowing that even if the initial conditions are restored it is almost impossible to return to the original vegetation cover.

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