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Weed flora analysis in El-Maadher agrosystem (Boussaada Oasis - Algeria). Análise da flora de ervas daninhas no agrossistema El-Maadher (Boussaada Oasis - Argélia).

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Abstract

The weed inventory in an arid land takes place to know and further control these plants. The study aims are to determine taxonomy, life form, chorology and to appreciate the weed harmfulness. A non-probabilistic sampling was conducted on five crops. We identified 41 species especially therophytes and mostly belong to the Mediterranean biogeographic element. The floristic richness by crop lets an average of 17 species and 24 for the richest. To assess the noxiousness, the partial indication of noxious obtains 21 potentially harmful weeds according to the frequencies. The numerical analysis of the data identified five groups. The weed noxiousness estimated by the abundance, frequency, and recovery, remains simple and efficient.
Keywords: Unwanted plants. Inventory. Noxious. DCA. Arid crops.

Resumo

O inventário de ervas daninhas em um terreno árido é feito para conhecer e controlar melhor essas plantas. Os objetivos do estudo são determinar a taxonomia, a forma de vida, a corologia e avaliar a nocividade das ervas daninhas. Uma amostragem não probabilística foi realizada em cinco safras. Identificamos 41 espécies especialmente terófitas e, em sua maioria, pertencem ao elemento biogeográfico Mediterrâneo. A riqueza florística por cultura permite uma média de 17 espécies e 24 para as mais ricas. Para avaliar a nocividade, a indicação parcial de nocivo obtém 21 ervas daninhas potencialmente nocivas de acordo com as frequências. A análise numérica dos dados identificou cinco grupos. A nocividade das ervas daninhas estimada pela abundância, frequência e recuperação, permanece simples e eficiente.
Palavras-chave: Plantas indesejadas. Inventário. Nocivas. DCA. Colheitas áridas.

Introduction

Unwanted plants found in cultivated areas are called "weeds" (HAMADACHE, 1995, p.7). They accompany cultivated species, whose presence is undesirable (ROBIN, 2014) because they show remarkable competition against agricultural crops. They have the potential to compete with crops for water, nutrients, carbon dioxide, solar radiation, and space (MISBAHULLAH et al., 2019, p.125) which adversely affect the crop production (SHAH et al., 2018, p.88).

Weeds are not insignificant pests insofar as they are considered as a biological constraint which affects agricultural production. These weeds are closely associated with the concept of competition (MONTEGUT, 1980) and generate some noxiousness. It should be noted that this noxiousness relates to each species of weed according to its presence, density, reproduction mode, and competition. The weeds study can help producers to determine the extent to which weed competition predicts the impact on crop performance and quality (MAJRASHI et al., 2017, p.762).

For this knowing the composition of the weed flora, its analysis, and its dominance in a particular cultural practice is an essential prerequisite for any development of control strategies (KAZI TANI, 2010, p.17).

The agricultural perimeter of El-Maadher near Boussaada Oasis presents various crops due to the presence of easy-to-work and movable land, water resources, abundant workforce and favorable conditions to agricultural production. The inventory of competing weeds was carried out on various agricultural speculations practiced in this area in order to better know and further control these plants.

This perimeter is an irrigated area without any chemical control intervention against these crop pests. So the study aims are to determine the taxonomy, the life form, the chorology, and the appreciation of weeds harmful to various crops by some parameters efficient and easy-to-appreciate the infestation of agricultural speculations.

The results and the measures are to be aware of and to take into consideration against weeds can undoubtedly increase the productivity of crops as well as their yield since they can easily be taken to appreciate noxious weed in order to eliminate them or at least minimize their impacts vs. crops.

In the present study, the inventory of weeds, their floristic analysis, and the assessment of their noxiousness is the first work of its kind in this area.

Material and Methods

Study area

To conduct our study of weed flora inventory in arid area and depending of certain agricultural speculations, we have chosen the perimeter of El-Maadher which is located northeast of Boussaada city about 8 km, the closest oasis of the capital Algiers of almost 240 km (Figure 1). It is the largest agricultural perimeter of M'Sila province which is situated in northeastern Algeria with an area of 25.000,00 hectares.

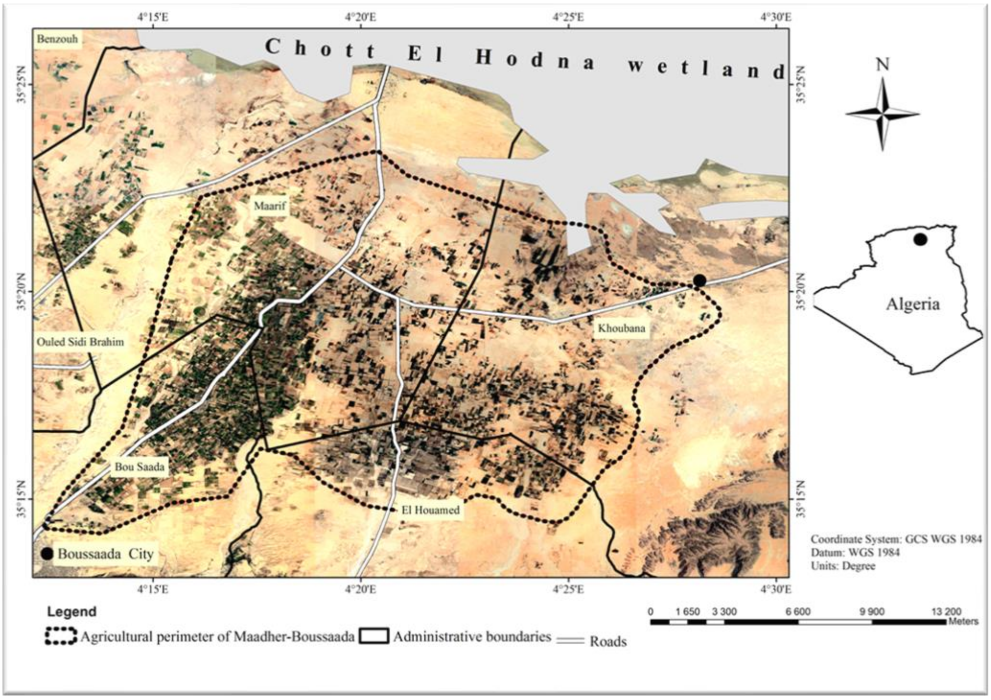

Figure 1 - Location of El-Maadher agricultural perimeter

According to weather data from the meteorological station of Boussaada (2006-2019), the study area belongs to the Mediterranean arid climate stage with mild winter (Q_2 = 15,43, m = 4,38 °C, M = 40,21 °C, P = 163,27 mm) and where the seasonal rainfall regime is Autumn–Spring–Winter–Summer. Drought can last the entire year. The landscape plants consist of a steppe formation encountered in sandy arid areas (psamophilous plants) such as those reported by Djebaili (1984); Zedam (1998, p.62) like *Aristida pungens* Desf., *Retama retam* Webb and C*utandia dichotoma* (Forsk) Trab and also those cited by Zedam, Fenni (2015, p.363) such as *Neurada procumbens* L. and *Bassia muricata* (L.) Asch.

Geologically, this area is continental deposits of the upper Eocene. Its relief is a plain of slight slope south of Chott El Hodna, a continental saline and dry wetland (ZEDAM, FENNI, 2015, p.357; ZEDAM, 2015, p.48). It is partly bordered by raw mineral soils (LE HOUEROU, 1995) due to the presence sometimes of mobile sand dunes. Hydrologically, this environment is linked to the arid rainfall regime which is reputed by strong irregularities and where the most rivers are temporary (MIMOUNE, 1995).

Sampling and data analysis

The agricultural perimeter of El-Maadher is irrigated and with no use of pesticides on crops. The cultures retained in this studied area are part of major food crops, forage and vegetable crops (Table 1).

Table 1 - Distribution of crop types by agricultural speculation

N°	Agricultural speculations	Crops	Previous crop	Long. (°)	Lat. (°)	Alt. (m)
01	Major food crops	Durum wheat	Oat	4,30064	35,31450	449
02	Forage	Alfalfa	Durum wheat	4,29892	35,31050	452
		Beetroot	Durum wheat	4,28911	35,30400	455
03	Vegetable crops	Lettuce	Alfalfa	4,29502	35,30340	454
		Fennel	Carrot	4,28538	35,30610	456

Long.: Longitude; Lat.: Latitude; Alt.: Altitude

These crops (Table 1) led us to choose a non-probability sampling: a subjective one with 06 replications for each crop (Figure 2) mentioned above and according to the following selection criteria:

- Homogeneity of plots and subplots (avoid gaps, stains…).
- Elimination subplots of edges to minimize the border effects as well as those located near ditches and places of intense prospection of weeds.
- Preferential choice of central subplots.
- Choice of repeat subplots as far as possible.

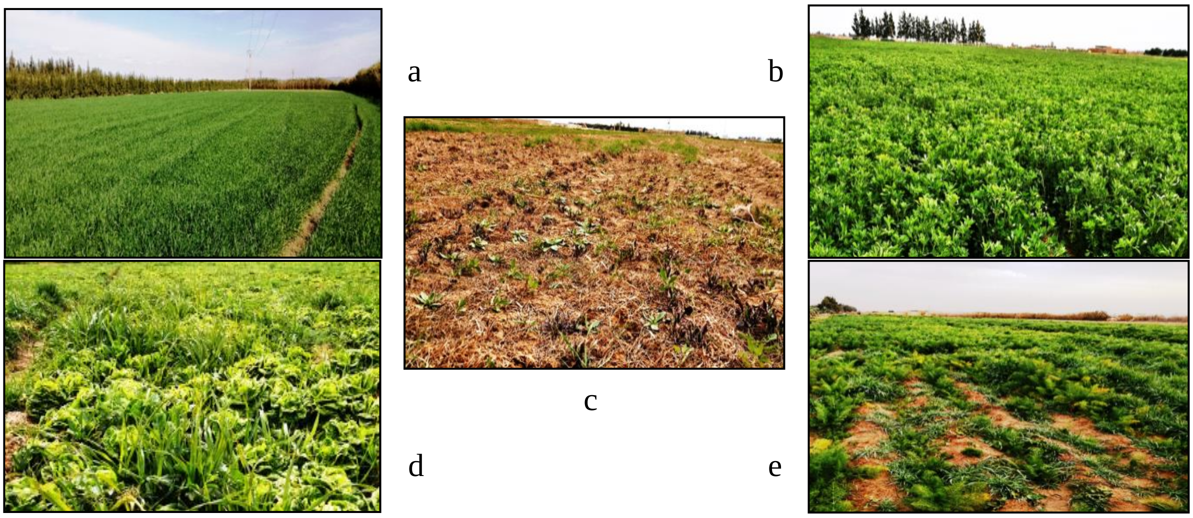

Figure 2 - Weed flora in crops at El-Maadher agricultural perimeter (a: Durum wheat; b: Alfalfa; c: Beetroot; d: Lettuce; e: Fennel; Original Photos: A. Zedam 2019)

The total number of the floristic samples therefore amounts is 30 samples (subplots). The execution of the samples was conducted subjectively in the crop fields. It took place during spring 2018 growing seasons. The samples were conducted in a homogeneous station in a minimum area (HAMEL et al., 2013). In all, this area was four square meters.

This minimal surface really expresses the area needed for a floristic sample (LACOSTE, SALANON, 2005) and it is the minimum area of a sample (HAMEL et al., 2013) used in the Braun-Blanquet method (GUINOCHET, 1973). Every species collected was assigned by a semi-quantitative coefficient: abundance-dominance: from "r" to "5". By using the floras of Maire (1952-1987); Quézel, Santa (1962-1963); Ozenda (2004); Dobignard, Chatelain (2010-2013) and the database

«Euro+Med Plantbase» available at www.emplantbase.org, all the obtained plants were determined and their geographic areas attained. Life cycles were known using those defined by Raunkiaer (1934). The voucher specimens were deposed at the Botanical Laboratory of Agricultural Sciences - Mohamed BOUDIAF University of M'Sila (Algeria).

The taxa nomenclature used, refers to the International Plant Names Index (IPNI) during the year of 2020 and which is available at: http://www.ipni.org.

Our data analysis focused firstly on the handling of the floristic samples and species for classify and order the data by using the Excel for Windows 2013 software where we proceeded to calculate the partial indication of noxious (PIN) which express the estimation of the species noxiousness. It was proposed by Bouhache, Boulet (1984) and used by Tanji (2001); Kazi Tani (2010); Zidane et al. (2010); Bassene et al. (2012) and which allows us to apprehend the noxiousness of the main species by considering that the most noxious and aggressive of them are those which have a high degree of presence (absolute frequency: FA) and a significant mean recovery (R):

$$PIN = (\sum R / FA) \times 100.$$

The average recovery is obtained by the transformation of abundance-dominance into percentage of recovery according to the Braun-Blanquet scale's (LAHONDÈRE, 1997; GILLET, 2000; DAJOZ, 2006; WALTER, 2006; MEDDOUR, 2011): 5= 87,5%; 4= 62,5%; 3= 37,5%; 2= 15%; 1= 2,5%; + = 0,1% and for the rare species "r" its negligible.

The PIN once calculated, it was divided in four groups by Kazi Tani (2010, p.192) and which are classified as follows: Group 1: PIN ≥ 5000**;** Group 2: 1000 < PIN <5000**;** Group 3: 500 < PIN ≤ 1000 and Group 4: PIN ≤ 500.

The classification of weeds according to their PIN and their relative frequency allows the appreciation of the nuisance degree of weeds through the crops (BOUHACHE, BOULET, 1984; TANJI 2001; KAZI TANI 2010; ZIDANE et al., 2010; BASSENE et al., 2012; CHABANI, LEMKHALTI, 2017). Finally we used a numerical analysis of the vegetation with the Dentrented Correspondence Analysis (DCA). This numerical analysis was realized by the free program: **PA**leontological **ST**atistics (**PAST**), version 3.25. Let's note that in the numerical analysis was employed with binary data species as refer to Gower (1971) (in JOHNSTON, 1976); Hill, Gauch (1980); Wolda (1981); Duarte et al., (1999); Dalirsefat et al., (2009); Faye (2010); Ghezlaoui et al., (2011); Kallio et al., (2011); Marcon (2013); Zedam (2015); Zedam, Fenni (2015); Zedam et al., (2016); Zedam et al., (2017); Hammer (2019).

We have converted our semi-quantitative coefficient of abundance-dominance into a qualitative coefficient of presence-absence (GILLET, 2000).

Results and Discussion

Flora analysis

a- Taxonomy

The total number of weeds inventoried is 41 taxa. This result has two classes: monocots with 07 taxa and dicots with 34. In addition, the ratio of the number of monocots to the number of dicots (M/D) for our study area is 20,59%. Compared to the ratio linked to the work on weed flora in northwest Algeria by Kazi Tani (2010, p.115) which is 16.12%, the effects of cultural practices on weed dynamics in the high Setifian plains (Algeria) which is 18.66% (KARKOUR, FENNI, 2016, p.55) and for western and central Morocco (BOULET et al., 1989, p.39) whose ratio is 19.94%, our result corroborates and confirms the predominance of the dicots in the weed flora.

Concerning the distribution according to botanical families (Table 2) there are 13. The most abundant family is the Asteraceae with 08 species (19,51%) followed by the Poaceae with 07 species (17,07%). The specifically poor families, eight in number (08), are either monospecific or bi-specific. They still represent almost 25% of the botanical families present in terms of the number of species per family.

Table 2 - Botanical families distribution

Family	Genera	Species	Rate (%)
Asteraceae	7	8	19,51
Poaceae	3	7	17,07
Brassicaceae	5	6	14,63
Fabaceae	4	5	12,20
Amaranthaceae	4	5	12,20
Malvaceae	1	2	4,88
Caryophyllaceae	2	2	4,88
Polygonaceae	1	1	2,44
Fumariaceae	1	1	2,44
Aizoaceae	1	1	2,44
Apiaceae	1	1	2,44
Resedaceae	1	1	2,44
Ranunculaceae	1	1	2,44
Total	32	41	100

Note that the most important families of weeds (Table 2): Asteraceae, Poaceae, Brassicaceae, Fabaceae, and Amaranthaceae alone hold nearly 72% of generic richness and over 75% of species one. The botanical family proportions of El-Maadher agricultural perimeter agree with those of the distribution of spontaneous Algerian flora where the dominant is the Asteraceae family (QUÉZEL, 1964). The species presence reflects the dynamics, adaptation and above all the invasion of agricultural areas by weeds where the source and origin are numerous: contamination by seeds, contribution by irrigation, animal movements, wind, anthropogenic activities... The neighboring places (borders) and the bands of breezes are not to be dismissed too.

b- Life form

For the 41 weed species identified, only three life forms were found:

- Geophytes: 02 species (04,88%).
- Hemicryptophytes: 06 species (14,63%).
- Therophytes: 33 species (80,49%).

This flora lets the life form dominated by therophytes which it is known by a short life cycle that enables them to resist to the instability of the agro-ecosystem (MAJRASHI et al., 2017, p.767). This fact can be explained that these places are disturbed by anthropic activities (FENNI, 2003; KAZI TANI, 2010, p.126) where many authors reported this same case result like Bouhache, Boulet (1984); Kazi Tani (2010); Zidane et al. (2010); Bassene et al. (2012); Karkour, Fenni (2016); Chabani, Lemkhalti (2017), Miderho et al. (2017), Fertout-Mouri (2018).

The low rate of hemicryptophytes is due to the arid conditions of our study area in one hand and in the other the plowing of the soil does not allow, stops and hinders perennial weeds to settle. Kazi Tani (2010, p.126) mentions that hemicryptophytes are particularly present in fairly stable environments, at the periphery of fields, waiting for a reduction in tillage to be introduced into cultivated plots.

It is the same case for the geophytes, which are unwanted in the plot and are continually destroyed up by tillage or by hand.

c- Chorology

The biogeographic origins of the 41 weeds identified are 17 (Table 3).

Table 3 - Chorological origins of the weed flora

Chorological origins	Species Number	Rate (%)
Cosmopolitan	8	19,51
Mediterranean	5	12,20
Paleo-temperate	4	9,76
Eurasian	4	9,76
Euro- Mediterranean	3	7,32
North African	3	7,32
Endemic North African	2	4,88
Mediterranean-Irano-Touranian	2	4,88
Mediterranean-Saharan	2	4,88
Ibero-Mauritanian	1	2,44
Circumboreal	1	2,44
Paleo-Subtropical	1	2,44
Macaronesian-Mediterranean-Irano-Touranian	1	2,44
European	1	2,44
Saharan	1	2,44
Mediterranean- Saharan-Sindian	1	2,44
Transcaucasian and cultivated elsewhere	1	2,44
Total	41	100,00

If we consider the Mediterranean element in its large sense, that is to say: Mediterranean, Euro-Mediterranean, North African, endemic North African, Mediterranean-Irano-Touranian, Macaronesian-Mediterranean-Irano-Touranian, Mediterranean-Saharan, Euro-Mediterranean, Ibero-Mauritanian and Mediterranean-Saharan-Sindian, there are 21 taxa (51,22%).

This reflects the geographical location of our study area and gives it the Mediterranean character (BOUHACHE, BOULET, 1984). In addition, cosmopolitan species are also present with 08 taxa (19,51%) but taxa of arid areas like *Enarthrocarpus clavatus* Delile ex Godr, *Pseuderucaria teretifolia* (Desf.) O. E. Schulz, *Bassia muricata* (L.) Asch. and *Diplotaxis erucoides* (L.) DC. are also present.

They were found in the nearest region of Chott El Hodna wetland (ZEDAM, FENNI, 2015, p.361, 363; ZEDAM, 2015, p.100, 101, 110, 120). As for the origins of the least represented taxa are represented by 12 species (29,26%) where numerous of them contain one species and they are qualified as singleton (MAGURRAN, 2004, p.68-69).

d- Weed richness

The distribution of the weed richness, in the plots for the cultivated speculations and according to the subplots (Table 4), shows that the fennel is the most attacked by the weeds compared to the durum wheat, alfalfa and beetroot which present less.

Table 4 - Weed richness in cultivated crops

	Crops	Durum	Alfalfa	Beetroot	Lettuce	Fennel	
Replications	Sub-plot 1	09	10	10	11	14	Total weed richness
	Sub-plot 2	06	09	09	10	14	
	Sub-plot 3	06	04	10	07	15	
	Sub-plot 4	10	11	10	13	14	
	Sub-plot 5	07	10	10	12	17	
	Sub-plot 6	07	06	11	09	14	
Average Presence		7,50	8,33	10,00	10,33	14,67	
Speculation richness		13	14	15	19	24	41

With regard to the floristic richness by crop, durum wheat encloses 13 species compared to fennel which records 24 where the previous crops were respectively oat and carrot. It knows that the carrot like a previous crop let the plot invade by weeds. This fact supposes the existence of a certain technicality of production in durum wheat where Hamadache (2013) reports that if the rotation is contented with a continuous wheat crop, the density of weeds goes from 28 to 237 plants.m^{-2}. The highest weed infestation rate has been observed when winter wheat follows winter wheat in a rotation (BABULICOVÁ, MENDEL, 2011, p.39) and in consequence weeds can decrease the value of a wheat crop through direct competition by reducing yields (BUSHONG et al., 2012, p.324). Concerning alfalfa, which is a dense forage crop, dominant and supporting repetitive cuts, is only invaded by 14 weeds. It is a reason why a good choice of rotation as alfalfa/wheat leaves the density of the weed flora per meter increases from 74 to 03 plants.m^{-2} (HAMADACHE, 2013). The vegetable crops like beetroot and lettuce are weed cleaners due to the maintenance work but in similar situation, Cioni, Maines (2010) emphasize that a reduce in the plowing depth can lead to a modification of the weed flora present in sugar beet farms. They record 15 and 19 species respectively where the lettuce has had the alfalfa as a previous crop which is considered as an excellent beginning of crop in rotations. These results can be explained by the absence of weed control work where Hamadache (2013) reports that the density of weeds in the potato/wheat rotation decreases from 42 to 01 plants.m^{-2} and Koocheki et al. (2009, p.405) cite that the rotation of sugar beet/winter wheat can reduce of 28% the soil weed seed bank. Finally, concerning fennel, it presents 24 weeds which is almost double observed in durum wheat. Indeed, of a part, the cereal has dense foliage with large leaves which are more competitive with weeds (HAMADACHE, 2013) and on the other the planting density in the cereal is much higher than that of this vegetable.

e- Weed noxiousness

After calculating the PIN to assess the noxiousness exerted by weeds on crops, we have classified weeds taking into account the absolute frequency and the relative frequency only for weeds having a value greater than 20% for the following reasons:

- The presence of the weed must be at least in 04 floristic surveys so that it is not considered as subservient only to speculation which already contains 03 subplots.
- It is encountered in at least 02 speculations or more.

We consequently obtained 21 species (51,22%) which are more than the half of the encountered weed found. They could be harmful and aggressive towards crops where their classification decreasing according to the values of the PIN and the relative frequencies (Table 5).

Table 5 - PIN values and frequencies retained for weeds

N°	Species	Life form	Absolute frequency	Relative frequency %	PIN
1	*Polygonum aviculare* L.	Hemicryptophy	18	60,00	2167,7
2	*Bromus rubens* L.	Therophyte	8	26,67	2000,0
3	*Bromus tectorum* L.	Therophyte	8	26,67	1125,0
4	*Sinapis arvensis* L.	Therophyte	18	60,00	1001,1
5	*Scolymus hispanicus* L.	Geophyte	10	33,33	827,00
6	*Silybum marianum* (L.) Gaertn.	Therophyte	10	33,33	652,00
7	*Fumaria officinalis* L.	Therophyte	8	26,67	625,00
8	*Diplotaxis erucoides* (L.) DC.	Therophyte	9	30,00	587,78
9	*Avena sterilis* L.	Therophyte	7	23,33	572,86
10	*Sisymbrium irio* L.	Therophyte	8	26,67	562,50
11	*Malva sylvestris* L.	Therophyte	14	46,67	553,57
12	*Hordeum murinum* L.	Therophyte	9	30,00	527,78
13	*Glebionis coronaria* (L.) Cass. ex Spach	Therophyte	10	33,33	526,00
14	*Chenopodium album* L.	Therophyte	7	23,33	504,29
15	*Sonchus oleraceus* L.	Hemicryptophy	8	26,67	501,25
16	*Malva aegyptia* L.	Therophyte	14	46,67	358,57
17	*Centaurea calcitrapa* L.	Hemicryptophy	12	40,00	166,67
18	*Anthemis punctata* Vahl	Therophyte	11	36,67	161,82
19	*Adonis aestivalis* L.	Therophyte	8	26,67	160,00
20	*Beta vulgaris* L.	Hemicryptophy	12	40,00	88,33
21	*Onopordum arenarium* (Desf.) Pomel	Hemicryptophy	14	46,67	08,57

Taking into account the PIN values, we have classified our weeds into four groups as already stated (Table 6).

Table 6 - Species noxious groups according to the values of the PIN

Groups	PIN values	Noxiousness appreciation	Number of weeds
Group 1: PIN ≥ 5000	00	Very high	00
Group 2: 1000 < PIN <5000	1001,11 to 2167,78	High	04
Group 3: 500 < PIN ≤ 1000	501,25 to 827,00	Moderate	11
Group 4: PIN ≤ 500	08,57 to 358,57	Low	06
Total			21

- Group 1: checked in no species for our case study.
- Group 2: includes four weeds. It is composed of an Hemicryptophyte *P. aviculare* (with an absolute frequency 18 out of the 30 surveys and a relative frequency of 60%) which tend to invade the premises where Dessaint et al. (2001, p.93) report that this species is a common species in the weed flora of annual crops in Côte-d'Or - France and can reduce wheat yield by up to 21% in west Australia (HASHEM et al., 2019). In the three Therophytes, we found *B. rubens* and *B. tectorum* belong to the genus *Bromus* and the Poaceae family. In this fact *Bromus* is a part of the weeds abundant to moderately abundant of high Setifian plains (Algeria) (KARKOUR, FENNI, 2016, p.59) and likewise Defalco et al. (2003, p.1046) note that *B. rubens* has a greater competitive potential than ecologically similar native winter annuals in Mojave desert (North America). The last one is *S. arvensis*, whose relative frequency reachs 60%. It is an invasive species with a very high seed-producing power: 300 to 2000 seeds.m^{-2} and it is a potential host of the scald-foot which is a formidable fungal disease for wheat (HAMADACHE, 2013).
- Group 3: encloses 11 weed species, it is the biggest one. *S. hispanicus* is a Geophyte and *S. oleraceus* is an Hemicryptophyte. The remaining are all Therophytes such as *H. murinum* which is considered to be a problematic weed and it is often grown in rotation with winter wheat and barley variety where it causes significant yield loss (BAGHESTANI et al., 2008, p.181). *D. erucoides* is considered as a weed for many crops (GUIJARRO-REAL et al., 2019, p.2) and is distributed along the Mediterranean areas of Europe and Africa to the Middle East (PIGNONE, MARTÍNEZ-LABORDE, 2011, p.138). *C. album* is a widely distributed, noxious weed in field crops such as maize, potatoes, sugarbeet and vegetables and ornamentals such as tulips (SCHEEPENS et al., 1997, p.75).
- Group 4: includes six weeds. There are three Hemicryptophytes *C. calcitrapa*, *B. vulgaris* and *O. arenarium* and three therophytes: *M. aegyptia, A. punctata* and *A. aestivalis*. The firsts record a high relative frequency and are remembered to be very sensitive to tillage where they behave like Therophytes.

Numerical analysis of the weed flora

The analysis gathering the speculations (subplots) and the weed flora met in the crops, by the dentrented correspondence analysis (DCA), let appear the following (Figure 3).

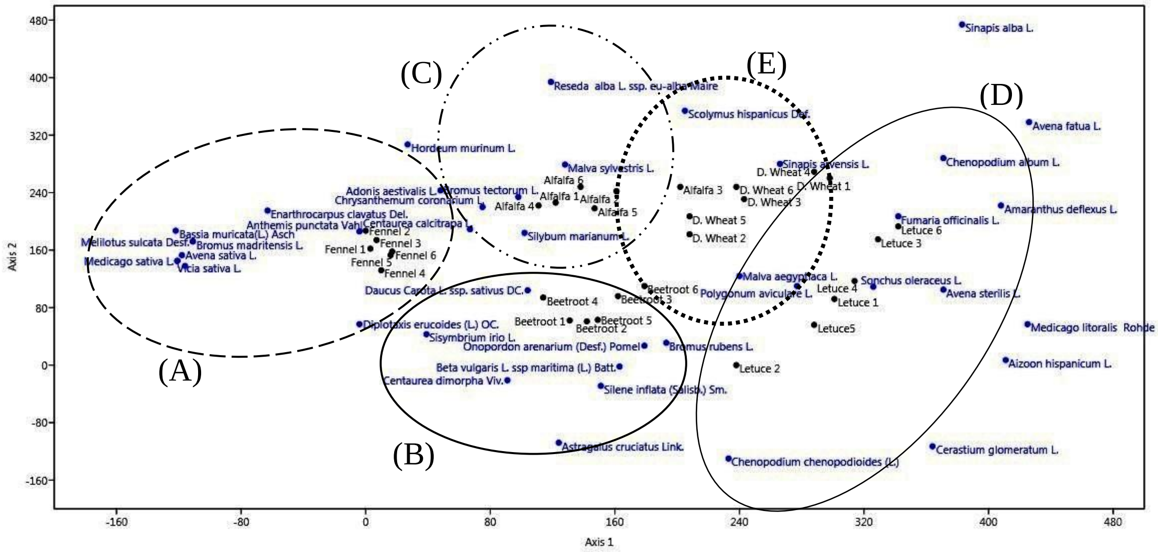

Figure 3 - DCA of study stations (subplots) and weed species encountered

The numerical analysis (DCA) of the weed flora has identified five groups of weeds specific to each speculation (Figure 3) where it encountered a high PIN and relative frequency greater. These crop groups are:

- The set (A) brings the fennel's group with the weeds like *D. erucoides*, *G. coronaria* and *H. murinum*.
- The set (B) includes the beetroot subplots and encloses the weeds as *B. rubens* and *S. irio*.
- The set (C) includes the alfalfa subplots and presents the weeds like *B. tectorum*, *S. marianum* and *M. sylvestris* where this last is mentioned by Hannachi, Fenni (2013, p.30) as an abundant species with an average level of infestation among crop weeds from Batna region (Algeria) and it is qualified as broadleaf weed which is very significant in the wheat crops of Afghanistan (MOHAMMADI, ISMAIL, 2018, p.12).
- The set (D) includes the lettuce sub-plots bring noxious weeds as *S. oleraceus*, *F. officinalis* and *A. sterilis* where the first is encountered at the highest level in Taif agricultural area of Saudi Arabia (MAJRASHI et al., 2017, p.766) and reported by Dhammu et al. (2020) as a less competitive weed species in wheat. The second weed, it is cited by Karkour, Fenni (2016, p.57) as an abundant weed species in crops. Concerning *A. sterilis* (the wild oat), it is one of the most abundant and competitive grass weeds present in temperate areas worldwide (CASTILLEJO-GONZÁLEZ et al., 2014, p.57), it is a weed commonly found in wheat growing areas of Turkey (ATAK et al., 2016, p.11150) and considered as an abundant and harmful weed in the winter cereals grown in Greece (PAPAPANAGIOTOU et al., 2012, p.118).
- The set (E) brings together the sub-plots of durum wheat and presents two noxious weeds like *P. aviculare, S. arvensis* and *S. hispanicus* which is a prickly perennial herb with a circum-Mediterranean distribution (POLO et al., 2009, p.2) and it can be found in uncultivated agricultural fields and cereal crops.

In summary, the crops investigated in the arid agrosystem of El-Maadher, near Boussaada Oasis area, are dependent on noxious weeds as mentioned as below (Table 7).

Table 7 - Crop-dependent noxious weeds in Maadher-Boussaada area

Crops	Weeds record high PIN and relative frequency greater	Noxiousness (*)
Fennel	*Diplotaxis erucoides* (L.) DC.	++
	Hordeum murinum L.	++
Beetroot	*Bromus rubens* L.	+++
	Sisymbrium irio L.	++
Alfalfa	*Bromus tectorum* L.,	+++
	Silybum marianum L.	++
	Malva sylvestris L.	++
Lettuce	*Fumaria officinalis* L.	++
	Avena sterilis L.	++
	Sonchus oleraceus L.	++
Durum wheat	*Polygonum aviculare* L.	+++
	Sinapis arvensis L.	+++
	Scolymus hispanicus L.	++

(*) : +++ : High ; ++ : Moderate.

Conclusion

The weed flora inventory, in an arid agro-ecosystem located in the agricultural perimeter of El-Maadher near Boussaada Oasis, lets it dominated by the Asteraceae botanical family and the annual life cycle. Chorologically, the Mediterranean origin overlooks and reveals the Mediterranean character of the studied area. The investigated crops let the fennel the most attacked crop by weeds compared to the other speculations which present less due to the plantation density, foliage, size leaves, rotation, technicality of production and field work… The noxiousness is related to each species of weed according to its presence, density, mode of reproduction, and competition. Our study has resulted in potentially invasive weeds competing with crops where we identified several species relative to investigated crops which register a significant presence and indicate a formal pest. This noxiousness is estimated by the abundance, the frequency and the recovery, which remain simple and effective parameters for the appreciation of the infestation of the cultures by this weed flora. For this it is strongly recommended by prophylactic measure and to fight against this flora, to sanitize the crop surroundings, under the foliage, and near the existing windbreaks which are considered as nurseries of these crop pests.

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