Agriculture and Forestry Journal
Vol. 9, Issue 1, pp. 23-30, June, 2025
P-ISSN 2773-3122 / E-ISSN 2602-5795
Published by university of Tlemcen - ALGERIA

Available online at:
https://journals.univ-tlemcen.dz/AFJ/index.php/AFJ
Open Access

A New Census of Alien Weeds Present in Crops of Oranie (Northwest Algeria) and a Comparative Study of Their Functional Traits With Native Weeds

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ARTICLE INFO

Article history:

Received: May 01[st], 2025
Accepted after corrections: June 11, 2025

Keywords:

Alien weeds, Agrosystems, Field surveys, Phylogeny, Life-history traits, Oranie

ABSTRACT

The alien crop weed flora of Oranie (Northwest Algeria) presented in this study which is based on fieldwork carried out by the first author up to September 2023, as well as on the literature found to date. The analysis of Oranie's weed flora showed 36 species of alien species which represent 2% of the 1,780 species of the whole spontaneous flora of the Oranian phytogeographic territory and 8% of the local weed flora. Almost 50% of these species were native to the American continent and about 63% came from several tropical regions. The most representative life-history traits of these alien species compared to native ones: were: annual cycle (75% versus 76%), summer germination (78% versus 13%), non-specialized dissemination strategies, but related with anthropic activities (75% versus 46%), self-pollination (73%), and the high proportion of C4 species (36.11% versus 3%). The agricultural biotopes mainly affected are summer-irrigated crops with short rotation and an important nitrogenous fertilizers assignment. There are very few such habitats in Oranie, and few summer annuals in Algeria's flora. The success of alien weeds seems to result from the suitability between environmental conditions of a newly created habitat (summer temperature, humidity, important nitrogen rate, frequent perturbations, short rotations, and ecological niches available) and species characteristics (annual type, summer germination, photosynthetic pathway in C4). Dispersal strategy and fecundation types seemed not to be of much importance in characterizing these alien species.

1. Introduction

Alien plants are introduced taxa (non-native or non-indigenous) whose presence in an area is due to intentional or unintentional human involvement (Lambdon et al., 2008; Fried et al., 2024). An alien taxon can occasionally reproduce outside of cultivation, but eventually dies out because it cannot form a self-replacing population, it is considered casual (Lambdon et al., 2008; Fried et al., 2024). This contrast with a naturalized alien taxon, which is capable of producing self-sustainable populations for a long period, by seeds or vegetatively, without or despite human intervention, enough to experience climate changes in the area where it occurs (Lambdon et al., 2008). In the present study, following Fried et al. (2024) in their analysis of the French alien flora, we consider as alien only the species that have been introduced subsequently to 1,500 A.D. A certain number of common life-history traits characterize those species: short life cycle, high and efficient sexual reproduction, high dispersal ability, autogamy, polyploidy, phenotypic plasticity due to genetic diversity (Roy, 1990).

Surprisingly, species introduction is not a real threat to Mediterranean ecosystems (Blondel & Aronson, 1999). Today, only 1% of the Mediterranean Basin's flora can be considered as exotic species and very few have known dramatic expansion. The low invasiveness of Mediterranean ecosystems contrasts sharply with the situation in other regions of the world characterized with Mediterranean-type climate: 20% for California, 54% for Southwest Australia, and 57% for South Africa (Blondel & Aronson, 1999; Quézel, 2002). We should not forget that California was settled by people from the Mediterranean itself and that the earliest introductions came from the Iberian Peninsula. While the success of introduced species from the Mediterranean to other Mediterranean-type regions of the New World is due to their pre-adaptation to a set of environmental factors (fire, overgrazing, soil disturbance, climatic pressures) the reasons for relative resistance to species introduction in the Mediterranean Basin is relatively resistant to species introduction are not well known (continuous human activities and disturbances for many millennia, all available ecological niches optimally used) (Di Castri *et al.*, 1990; Breton, 1997; Blondel & Aronson, 1999). Native weeds had enough time to evolve and to occupy cultivated habitats with very high performance.

Only a deep knowledge of both life-history traits and intrinsic species attributes (biological, ecological and genetic), in interaction with the characteristics of the colonized environment would explain the survival success of alien species in their new environment. Numerous studies have focused on the determination of suites of traits that make alien species successful invaders (e.g. for Australia: Newsome & Noble, 1986). Even if a certain number of general attributes allow defining invaders, some exceptions remain unexplained (Roy, 1990). No species embraces all the typical characteristics of a good invader, and not all these latter are necessary for a given species to become invasive (Roy, 1990). Identifying a group of traits associated with invading ability unique to all plant species seems impossible (Williamson, 1999). However, the comparative approach of life-history traits between alien weeds and native (or indigenous) weeds remains necessary to identify key-factors allowing to understand the colonization process and thus helping to elaborate a better management of these exotic invasive species (Baker, 1965; Roy, 1990; Maillet & Lopez-Garcia, 2000; Cadotte et al.,2006).

Oranie, a geographic area of about 30,000 km^2 in north-west Algeria (Figure 1), shelters about 1,780 flowering plant species, i.e. 57% of the total flora of the country (Quézel & Santa, 1962-1963). In this Mediterranean region, we have characterized, in a previous paper based on 547 vegetation surveys in rain fed (winter cereals, vines, stone trees, etc.) and irrigated fields (summer market gardening, citrus orchards, etc.), the 245 weed species according to agrosystems and environmental conditions (Kazi Tani et al., 2010). The present work displays the results of a comparative analysis between some selected life-history traits of alien weeds and those presented by native weeds to better understand their development, and the agroenvironmental conditions which assist them to prevent the development of new species noxious to crops.

2. Materials and Methods

2.1. Study Area

The geographical area designated Oranie is located in the northwestern part of Mediterranean Algeria (Figure 1). It covers a territorial strip of approximately 30,000 km^2. The Coastal Plains sub-sector includes the Low Coastal and Sub-Coastal Plains and is the area where the majority of agricultural activities in Oranie are concentrated.

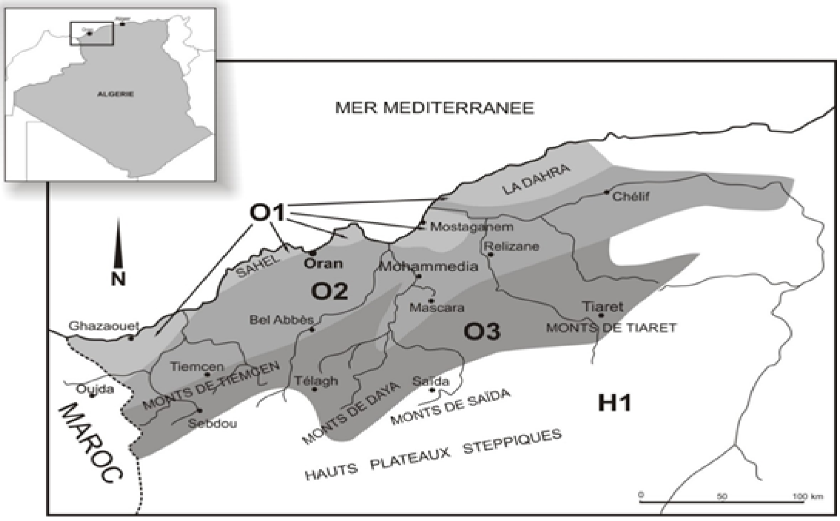

Figure 1. Phytogeoraphic division of Oranie according to Quézel and Santa (1962). O1 : Coastal Sahel sub-sector, O2 : Coastal plain sub-sector, O3 : Tellian Atlas sub-sector.

2.2. Introductory note

This work is essentially an update of our paper (Kazi Tani et al., 2012) published a dozen years ago. An updated database based on bibliography (Houmani et al., 1999; Kazi Tani et al., 2012; Kazi Tani, 2012; Kazi Tani, 2013; Kazi Tani, 2014; Adjim & Kazi Tani, 2018) and on fieldwork carried out by the first author up to September 2023 was created comprising all listed alien crop weed species with their respective Latin names according to GBIF database (The Global Biodiversity Information Facility, 2002) and the seven following biological attributes (appendix 1): (1) geographical origin, (2) we use biological cycles because they fall within the field of agronomy while botanists use the biological types.

We will give the equivalence of the terms between vegetative cycle and biological type, (3) germinating period, (4) dispersal types, (5) reproductive types, and (6) photosynthetic types. However, a certain number of cells remained empty for lack of information, especially concerning reproductive type of native weed species. Next, we have realised a comparison between alien and native weeds based on the selected biological attributes to see whether there were any differences in the frequencies of these attributes between the two categories of weeds.

Concerning dispersal methods, we distinguished 3 classes: less than 5m – short distance (non-specialized dissemination strategies or clithochory), from 5 to 100 m – medium distance (insects, water runoff), and more than 100m – long distance (river water, wind, wild animals, sheep, cattle, birds, agricultural machinery). Most weeds, even those that show no special anatomical adaptations in their diaspores, are easily dispersed by water (middle distance dispersal), and structural modifications of nautohydrochory (ability for floating and transporting on the surface of water) are often based on wind dispersal (Radosevich & Holt, 1984; Van Der Pijl, 1982). The differences between the selected biological attributes of alien weeds and native weeds have been statistically evaluated through a chi-square test (χ^2) implemented under *R* (R Development Core Team, 2010).

3. Results

3.1.Distribution of the alien weed flora according to crop types

A checklist of thirty-six species of alien weeds has been established for the crops of Oranie (appendix 1) representing 8% of the 413 weed species thriving in the fields of the area (Kazi Tani et al., 2010), and 2% of the total plant species present in the Oranian phytogeographic territory. Alien weed flora distribution according to the studied crop types is listed in Table 2. χ^2 test cannot be worked out directly because there is only one alien species in fallows and two in winter cereals.

Table 2. Distribution of Oranie's alien weeds according to crop types.

	Crop types						
	Summer irrigated market gardening	Rain-fed vegetables	Non-irrigated Orchards	Irrigated Orchards	Vineyards	Winter cereals	Fallows
Number of weeds	81	174	139	112	191	275	272
Number of aliens	25	2	7	10	3	3	3
% aliens compared with the total weed	30.86	1.15	5	9	1.57	1	1.10
%natives compared with the total weed	69.14	98.85	95	91	98.43	99	98.9
% aliens by crop compared with the total alien weed	69.44	5.55	19.44	27.77	8.33	8.33	8.33
Statistical test by crop	$\chi2$=11.846, *p*<0.001	$\chi2$=66.216, p<0.001	$\chi2$=112.4, p<0.001	$\chi2$=75.571, p<0.001	$\chi2$=179.19, p<0.001	$\chi2$=263.13, p<0.001	$\chi2$=260.13, p<0.001

Alien weeds settle mostly in summer irrigated market gardening and to a lesser degree in the summer facies of irrigated orchards, namely *Citrus* groves. The latter even includes some alien phanerophytes with extremely rare and accidental presence such as *Melia azedarach* L. and *Lantana camara* L. and which we did not see fit to add to the big table in appendix 1. The crops that are very low in exotic weeds belong to the cereal-fallow land utilization system. Among perennial ligneous crops, orchards show more alien species than vineyards.

3.2. Comparative phylogeny of the alien and native weed flora

The totality of the reported alien weed species (36) is Angiosperms distributed in 10 botanical families and 22 genera of which (Table 3):

- 2 families, 6 genera and 8 species of Monocots.
- 8 families, 16 genera and 28 species of Eudicots.

As for the native weed flora (413 species), as for it, is distributed in 49 Angiosperms families and 206 genera of which (Kazi Tani et al., 2010):

- 5 families, 34 genera and 53 species of Monocots.
- 44 families, 172 genera and 360 species of Eudicots.

Table 3. Oranie's alien and native weed comparative phylogeny.

Angiosperms	Phylogeny	Alien weed flora	Native weed flora
	Families	2	5
Monocots	Genera	6	34
	Species	8	53
	Families	8	44
Eudicots	Genera	16	172
	Species	28	360

The three largest alien weed families are: *Asteraceae* (22.22%), *Poaceae* (19.44%) and *Amaranthaceae* (19.44%). The other botanical families totalize only 10 genera and 14 species (38.88%). As for the native weed flora, it is dominated by *Asteraceae* (15.76%), *Fabaceae* (12.70%) and *Poaceae* (10.58%) (Kazi Tani et al., 2010).

3.3. Comparative analysis of selected life traits of the alien weed flora versus native one

As shown on Table 4, weeds' biological spectrum as they are alien or native, is always dominated by annuals (75.78% *versus* 75%). On the other hand, the participation of vivacious in the spectrum is more important in alien weeds (19.44%) than in native weeds (7.02%). Within the vivacious, the rhizomatous ones seem to be numerically the most important (57%).

Table 4. Comparative table of selected functional traits of native versus alien weeds with $\chi 2$ test for each type of attribute (significance at 5% pointed out with an asterisk)

Weeds' attributes		***Native species (total = 413)***		***Alien species (total = 36)***		***Statistical test by attribute***
		Number	*%*	*Number*	*%*	
Biological cycles	Annuals	313	75.78	27	75	Fisher's p= 0.04
	Biennials	15	3.52	0	0	
	Vivacious	29	7.02	7	19.44	
	Perennials	56	13.17	2	5.55	
Germination	Spring and/or summer germination	52	12.59	28	77.77	Fisher's p<0.001
	Autumn and/or winter germination	270	65.34	5	19.44	
	Other	91	22.03	3	8.33	
Dispersals	Long distance	187	45.27	9	25	Fisher's p= 0 .003
	Medium distance	34	8.23	0	0	
	Short distance	192	46.48	27	75	
Photosynthesis	C_4	11	2.66	13	36.11	$\chi 2$= 66.76, ν = 1, p<0.001
	C_3	402	97.33	23	63.88	

Most of alien weeds (78%) have summer or spring prolonged germination. On the other hand, native weeds (65.34%) have a preferential autumn or winter germination. Short-distance dispersal is the main strategy for alien weeds, 75% *versus* 46.48% for native weeds. Long-distance dispersal is presented by 25% of the alien species *versus* 45.27% for natives. Medium-distance dispersal is observed in 8.23% of native species, while this dispersal strategy concerns 0% of alien weeds.

If many alien weeds (63.88%) are C_3 plants *versus* 97.33% for native species, C_4 plants are also quite important (36.11%), particularly among *Amaranthaceae* and *Poaceae* while they are represented in native weeds with only 2.66%. For both weed groups, the dispersal method restricted in space from the mother-plant or clitochory, remains the most widespread.

3.4. Reproduction systems and biological types

If most of the alien weeds (73%) show complete autogamy or combine with, very rarely are completely allogamous (13%). Sometimes the reproduction system is exclusively vegetative (16.66%) as it is the case for *Oxalis* spp. Concerning native weeds, we do not have data on reproduction types. In France, Maillet (1992) states, that in vineyards almost 82% of the weeds is self-compatible.

If we examine the repartition of biological cycles for alien weeds according to reproduction systems (Table 5), annuals seem to be preferentially autogamous or autogamous/allogamous, and the vivacious have almost exclusively a vegetative reproduction. Three of the allogamous species can also reproduce vegetatively. However, compared with the small number of inventoried alien weeds, it is not possible to draw statistically reliable conclusions.

Table 5. Reproductive systems and vegetative cycles contingency table for alien weeds

Biological types	Reproduction systems				
	Autrogamous	Allogamous	Auto/Allo	Vegetative	Total
Annuals	12	5	10	0	27
Vivacious	0	2	1	4	7
Perennials	0	1	0	1	2
Total	12	8	11	5	36

4. Discussion

The 36 alien weed species analysed in this study represent 2% of the 1,780 plant species harboured by the Oranian phytogeographic territory (Appendix 1). This figure should be compared with the 2% of anthropophytes reported by Le Floc'h et al. (1990) for North Africa. The biotopes that support the highest proportions of alien weeds are those characterized by their high humidity and nitrogen levels during summer, and their short crop rotation. This phenomenon has already been reported in other Mediterranean countries (for France: Maillet, 1997; for Israël: Dafni & Heller, 1982).

Such crops requiring high temperatures and permanent irrigations, themselves of foreign origin, have created habitats which do not necessarily exist before because they are historically recent for the area. In these agroecosystems, *r*-selected species (short life cycle, rapid growth rate, quick use of available resources, high proportion of biomass allocated to reproduction,) are fostered. The contrasting absence of alien weeds in fall and spring cultivations is that those agrosystems are very old in the region and that native weeds competitively occupy the cultivated biotopes for a very long time (Maillet, 1997). In return, the aestival type is less frequent among Mediterranean weed species, where the seeds are often dormant during the hot, dry season. But, many tropical or subtropical species are not dormant during that period. The need for a similar climate between the region of origin and that of reception is then evaded. The fact that very few spontaneous species can present an aestival cycle explains the success of many exotic species in Algeria. The same remark has been made for France (Jauzein, 2001).

The fact that *Asteraceae, Poaceae* and *Amaranthaceae* are the largest alien weed families (about 60%) has been reported in other Mediterranean countries such as Catalonia (Spain) by Recasens & Conesa (1998). Daehler (1998) remarked that *Poaceae* were overrepresented among weeds and invasive species and that they have the tendency of forming monospecific stands. However, at the level of North Africa, the great importance of *Asteraceae*, in the alien weed flora have been pointed out only in Algeria, whereas for most other countries, *Amaranthaceae* and *Brassicaceae* dominate alien weeds (Meggaro et al. 1998).

Generally, *Asteraceae* and *Poaceae* remain the largest weed families, native as well as alien, of cultivated lands in Oranie. However, at lower taxonomical ranks, things change. For the *Asteraceae*, taxa which belong to *Lactucoideae* (*Liguliflorae*) subfamily, with the tribe of *Lactuceae* are prevailing among natives, while taxa which belong to *Carduoideae* (*Tubulifloreae*) subfamily, with the tribes of *Astereae* and *Heliantheae* are prevailing among aliens. For the *Poaceae* taxa which belong to *Festucoideae* subfamily prevail among natives, while taxa which belong to *Panicoideae* subfamily prevail among aliens.

The low number of Afro-Tropical alien species (about 30%) is not only due to the massive Afro-Arabian deserts, dating back to the Miocene-Pliocene boundary (5-6 Myr B.P), which have seriously impeded south-north biological exchanges (Blondel & Aronson 1999), it is also and mainly due to the weakness of economic exchanges (especially agricultural products) between the people of sub-Saharan Africa and the people of the Maghreb (Algerian imports from sub-Saharan Africa are only around 2% (Mokhefi & Antil, 2012). The great majority of alien species (50%) come from the American continent, which is also often the place of origin of imported crop seeds, while the weakest participation is recorded for species from South Africa. Weeds of Tropical origin are quite numerous (63%), which corroborate observations made in other Mediterranean countries (e.g. Recasens & Conesa, 1998; Maillet, 1997). Alien weeds are mainly annuals (75.76%). A close percentage (70%) has been found in crops of Catalonia (Recasens & Conesa, 1998).

Concerning the life cycle, species with summer or prolonged spring germination are predominant (78%) among alien weeds. A close percentage (90%) has been found among exotic weeds present in crops of Catalonia (Recasens & Conesa, 1998). Native weeds show, contrarily, autumn or winter germination (65%). This is otherwise in complete conformity with the germination ecology of the Mediterranean flora for which the germination period for the great majority of species is a stickler for the two most humid seasons of the year, autumn and winter, the dead season being summer.

The proportion of C_4 species is particularly important in summer crops, where they represent very important hazards because they are among the most abundant, the most noxious and the most invasive species. C_3 species seem not to be capable of establishing in the crops unless they have an aestival cycle (*Xanthium* spp., *Datura* spp., *Abutilon* spp.), an important seed production suited with long-distance dispersal and adapted to a broad range of habitats (Maillet, 1997).

The main dispersal strategy of alien weeds is clitochory (75%), which proves that their spread requires human intervention, and that establishment prevails over dispersal, avoiding a useless waste of energy. A quite close number has been found by Recasens & Conesa (1998) for the exotic weeds of Catalonia (65%).

Annuals seem to be completely or preferentially autogamous. The same observation has been made by Maillet (1992) in France. Exclusive autogamy or combined with allogamy seems to promote synanthropization, i.e. the establishment of a given species in man-modified or man-made biotopes (Cronk & Fuller, 1995; Maillet, 1997). Mixed reproduction system (autogamy/allogamy) allows, effectively, the foundation of new populations with a reduced number of individuals (Stebbins, 1971). However, the hypothetical advantage of an autogamous reproduction as an important weediness character (Baker, 1974) has not been verified in the case of Oranie's alien weeds. More than one reproduction type or another, it's the flexibility of the reproduction system that is the cause of alien species success.

5. Conclusion

Although the exotic weed flora of Oranie belongs to a great diversity of botanical families and genera that it does not allow any serious prognosis of future invasions. Two remarks can however be made: the success met with different species of the genus *Amaranthus* in Oranie (six alien species already present in the crops of the region), the richness of this genus (fifty species around the world) and its very high seed output (more than 40,000 seeds/individual) having great longevity let predict other invasions of the agrosystems (e.g Iamonico & El Mokni, 2019). Two other species are potentially candidates to invade Oranie's cultivated lands, the populations of which need to be watched over with caution: *Ipomoea sagittata* Poir. (*Convolvulaceae*) (e.g. Hançerli et al., 2018) and *Artemisia verlotiorum* Lamotte (*Asteraceae*) (e.g. Sanze Lorza et al., 2004) present in the region on more or less artificialized habitats (littoral marshes, rubbish) and are stated as invasive in other West-Mediterranean countries.

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Appendix 1. Biological attributes of the 36 alien weed species present in crops of Oranie

Species	Families	EPPO code	Crop types	Origin	Bio. cycles	Germ.	Disper.	Reprod.	C_3/C_4
Abutilon theophrasti Medik.	*Malvaceae*	ABUTH	SC/VC	Euras.	A.	Sp,S	short	Auto	C_3
Amaranthus albus L.	*Amaranthaceae*	AMAAL	S	N. Amer.	A.	Sp,S	short	Auto/Allo	C_4
Amaranthus blitum L.	*Amaranthaceae*	AMALI	S	Pantrop.	A.	S	short	Auto/Allo	C4
Amaranthus deflexus L.	*Amaranthaceae*	AMADE	VC	Amer.	V.rh	S	short	Auto/Allo	C_4
Amaranthus graecizans L. subsp. *silvestris* (Vill.) Brenan	*Amaranthaceae*	AMAGS	S	Euras.-Af.	A.	Sp,S	short	Auto/Allo	C_4
Amaranthus hypochondriacus L.	*Amaranthaceae*	AMAHP	S	Amer.	A.	Sp,S	short	Auto/Allo	C_4
Amaranthus retroflexus L.	*Amaranthaceae*	AMARE	S	N. Amer.	A.	Sp,S	short	Auto/Allo	C_4
Symphiyotrichum squamatum (Spreng) G.L. Nesom	*Asteraceae*	ASTSQ	S	S. Amer.	A.	Sp-S	long	Allo	C_3
Ceratochloa unioloides (Willd.) P. Beauv.	*Poaceae*	BROCA	CO	S.Amer.	P.	Sp,A.	long	Allo	C_3
Chenopodium ambrosioides L.	*Amaranthaceae*	CHEAM	S	Amer.	A.	Sp,S	short	Allo	C_3
Cuscuta campestris Yunck.	*Convolvulaceae*	CVCCA	A/VC	N.Amer.	A.	Sp.S.	short	Allo/veget	C_3
Cuscuta suaveolens Seringe	*Convolvulaceae*	CVCSU	VC	S. Amer.	A.	S	short	Allo/veget	C_3
Cyperus rotundus L.	*Cyperaceae*	CYPRO	O/VC	Paleo-Trop.	V.tu	S	short	Vegetative	C_4
Datura ferox L.	*Solanaceae*	DATFE	CE/VC	C. Amer.	A.	S	short	Auto	C_3
Datura stramonium L.	*Solanaceae*	DATST	CE/VC	Amer.	A.	S	short	Auto	C_3
Digitaria sanguinalis (L.) Scop.	*Poaceae*	DIGSA	VC	Thermo-cosm.	A.	S	short	Auto	C_4
Echinochloa colonum (L.) Link.	*Poaceae*	ECHCO	CO/VC	Pantrop.	A.	S	short	Auto	C_4
Erigeron canadensis L.	*Asteraceae*	ERICA	S	Amer.	A.	Sp,S,A	long	Auto/Allo	C_3
Erigeron bonariensis L.	*Asteraceae*	ERIBO	S	Amer.	A.	Sp,S,A,W	long	Auto/Allo	C_3
Galinsoga parviflora Cav.	*Asteraceae*	GASPA	N	S.Amer.	A.	A.,W.	long	Auto	C_3
Gundelia tournefortii L.	*Asteraceae*	GUNTO	O	Iran.-Tur.	V.rh	A,W	long	Allo/veget	C_3
Gypsophila pilosa Huds	*Caryophyllaceae*	GYPPI	WC/DV	Medi-Iran.-Tur.	A.	A.,W	short	Allo	C_3
Hibiscus trionum L.	*Malvaceae*	HIBTR	VC	Trop.	A.	S	short	Auto/Allo	C_3
Oxalis compressa L. f.	*Oxalidaceae*	OXACM	O	Af.S.	V.bu	Sp,S	short	Vegetative	C_3
Oxalis pes-caprae L.	*Oxalidaceae*	OXAPC	CO	Af.S.	V.bu	Sp,S	short	Vegetative	C_3
Paspalum distichum L.	*Poaceae*	PASDS	O/VC	Pantrop.	V.rh	Sp,S	short	Vegetative	C_4
Salpichroa origanifolia (Lam.) Baill.	*Solanaceae*	SAPOR	CO	S.Amer.	P.	Sp-S	short	Vegetative	C_3
Setaria pumila (Poir.) Roem. & Schult.	*Poaceae*	SETPU	VC	Thermo-cosm.	A.	S	short	Auto	C_4
Setaria verticillata (L.) P.Beauv.	*Poaceae*	SETVE	VC	Thermo-cosm.	A.	S	short	Auto	C_4
Setaria viridis (L.) P.Beauv.	*Poaceae*	SETVI	VC	Temp.-Subtrop.	A.	S	short	Auto	C_4
Solanum elaeagnifolium Cav.	*Solanaceae*	SOLEL	O/WC	N.Amer.	V.rh	W,Sp.,S.	short	Auto/Allo	C_3
Solanum rostratum Dunal	*Solanaceae*	SOLRS	O	N.Amer.	A.	A	short	Auto/Allo	C_3
Veronica persica Poir.	*Plantaginaceae*	VERPE	VC	W. As.	A.	A,W	short	Auto/Allo	C_3
Xanthium orientale L. subsp. *italicum* (Moretti) Greuter	*Asteraceae*	XANSI	O	Amer.	A.	S	long	Auto	C_3
Xanthium spinosum L.	*Asteraceae*	XANSP	S	S.Trop.	A.	S	long	Auto	C_3
Xanthium strumarium L.	*Asteraceae*	XANST	O	S.Trop.	A.	S	long	Auto	C_3

Crop types: A, alfalfa; CO, citrus orchards; DV, dried vegetables; N, nurseries; O, non-irrigated orchards; SC, summer cereals; VC, summer vegetable crops; WC, winter cereals- Origin: Af., Africa; Amer., America; As., Asia; Euras. Eurasia; Iran.-Tur., Irano-Turanian; Temp.-Subtrop., Temperate-Subtropical; Thermo-cosm., Thermocosmopolite; Trop., Tropical – Biological cycles: A., annual (therophyte and parasite); V., vivacious (geophyte) (rh., rhizome; bu, bulb; tu, tubercule); P., pluriannual (hemicryptophyte, nano-phanerophyte) – Period of germination: A, autumn; W, winter; Sp, spring; S, summer – Reproduction type: Auto, autogamous; Allo, allogamous; vegetative – Photosynthetic type: C_3 or C_4.

Please cite this Article as:

KAZI TANI C., LE BOURGEOIS T., MUNOZ F., 2025. A New Census of Alien Weeds Present in Crops of Oranie (Northwest Algeria) and a Comparative Study of Their Functional Traits With Native Weeds. *Agriculture and Forestry Journal*, 9(1) : 23–30.
https://doi.org/10.46325/afj.v9i1.188