

Eruca aurea Batt, the Saharan Rocket

How to put an end to the confusions within the genus *Eruca* ?

Claude Lemmel & Zahora Attioui

Al Yasmina 2:6 (2021)

Claude Lemmel
claude.lemmel@atlas-sahara.org

Photos : Zahora Attioui & Claude Lemmel
www.atlas-sahara.org

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20190312 - Merzouga - gps: 31.0838,-4.0685 - altitude: 701m.
Eruca foleyi (blue flowers) and *E. aurea* (yellow flowers)
in the riverbed of wadi Ziz after a flood.

Abstract

The taxonomy of the genus *Eruca* is confused.

The European flora attribute to this genus 2 or 3 taxa (*vesicaria*, *sativa*, [*longirostris*]).

René Maire in the «Flore de l'Afrique du Nord» recognizes a single species with 5 subspecies and 9 varieties.

According to our field work*, there is in the eastern Morocco a North-South gradient of 4 *Eruca* species from the Mediterranean Basin to the Sahara, including *Eruca aurea* Batt. a «ghost species» forgotten by botany.

To resolve this confusion we give a detailed morphological comparison of the two best characterized yellow-flowered rocket species in their respective lineages, *Eruca pinnatifida* (Desf.) Pomel and *Eruca aurea* Batt.

We propose an identification key for the *Eruca* of the western Palearctic and the typification of the 6 species that we recognize.

Then we specify which genetic analyzes should be programmed to validate (or invalidate !) at the phylogenetic level the findings of our chorological and morphological studies.

Résumé

La taxonomie du genre *Eruca* est confuse.

En Europe on attribue à ce genre 2 ou 3 taxons (*vesicaria*, *sativa*, [*longirostris*]).

René Maire dans la Flore de l'Afrique du Nord reconnaît une seule espèce avec 5 sous-espèces et 9 variétés.

D'après notre travail de terrain*, il y a pour l'Est du Maroc un gradient Nord-Sud de 4 espèces d'*Eruca* depuis le pourtour méditerranéen jusqu'au Sahara, y compris *Eruca aurea* Batt., une «espèce fantôme» oubliée par la botanique.

Pour lever cette confusion nous donnons une comparaison morphologique détaillée des deux espèces de roquettes à fleurs jaunes les mieux caractérisées dans leurs lignées respectives, *Eruca pinnatifida* (Desf.) Pomel et *Eruca aurea* Batt.

Nous proposons ensuite une clef de détermination des *Eruca* du paléarctique occidental et la typification des 6 espèces d'*Eruca* que nous reconnaissons.

Puis nous précisons quelles seraient les analyses génétiques à programmer pour valider (ou invalider !) sur le plan phylogénétique les résultats de nos études chorologiques et morphologiques.

* web => <https://alyasmina.org/Eruca/01-eruca.html>

1.1 - Repartition of *Eruca* in eastern Morocco : *Eruca longirostris* Uechtritz

« On the way from Oudjda to Naïma ... during our visit, the land subjected from time to time to plowing or more exactly to scratching, was literally covered with a small annual crucifer of yellowish-white color : *Eruca sativa* v. *longirostris* . We had never seen such masses of an annual species : it is by billions that it invades the plains, from Lalla-Marnia to El-Aïoun. »

Braun-Blanquet J. & Maire R., 1924
Étude sur la végétation et la flore marocaines

It is in the same plains traveled by Braun-Blanquet and Maire in 1924 that we photographed this rocket in the spring of 2020 and 2021 ; those years had not been very rainy, the rockets were not very dense and did not exceed a height of 20cm. They nevertheless formed immense carpets of a creamy white color.

We found this rocket again in the High Atlas, near Imilchil, at an altitude of almost 2200m, forming a ring around the marshy meadows managed as Agdal.



20200131 Zaïo gps : 34.8923,-2.7211 altitude : 90m



20210404 Zaïo-HassiBerkane gps : 34.8923,-2.8448 alt. : 169m.



20210404 N2-Berkane-Zaïo gps : 34.8913,-2.4008 altitude : 192m.



20180516 BouAzrou gps : 32.1112,-5.5510 altitude : 2230m.
Around the marshy meadow there are two belts of crucifers : the inner belt is formed by *Lepidium draba* L. and the outer belt by *Eruca longirostris* Uechtr.

In the photo below, the pods have hairy valves and very long rostrums, which eliminates any risk of confusion with *E. sativa* Mill.



1.2 - Repartition of *Eruca* in eastern Morocco : **Contact *longirostris* / *pinnatifida***

Eruca longirostris is carried by the wadis to the foothills of the High Atlas where it can grow in the company of *Eruca pinnatifida*. We did not find any hybrid plants between these two taxa which we will use later as an argument to justify that we will treat these taxa as distinct species.

Note the color differences between the populations of *E. longirostris* on the edge of the Mediterranean whose flowers are creamy white, those of the High Atlas pure white and those of the foothills pale yellow.



Very difficult to tell the different species of *Eruca* just studying small samples of dry plants, but much easier in the field ! To the left, *Eruca pinnatifida*, to the right *Eruca longirostris*.



We recognize on the left *E. pinnatifida* with flower buds that protrude above the open flowers. We recognize on the right *E. longirostris* with its small, deeply indented stem leaves.

1.3 - Repartition of *Eruca* in eastern Morocco : *Eruca pinnatifida* (Desf.) Pomel

In eastern Morocco, *Eruca pinnatifida* is a plant from the transition zones between Mediterranean and Saharan vegetation. It is found in the south of the highlands of the Oriental in the last steppes covered with alfa. In the eastern High Atlas, it can be found on arid southern slopes up to 1800m altitude. It is particularly abundant in the Saharan foothills of the eastern High Atlas but does not venture into the Sahara itself.

Eruca pinnatifida is immediately recognizable by its very vertical habit and its long floral stems which are most often 1m tall but can in good conditions exceed 2m !



20190428 N17-Tendrara gps : 32.7601,-2.0703 altitude : 1323m.
Colonizing the bare areas between the clumps of alfa in the southern highlands of the Oriental.



20210426 Tamtatouchte gps : 31.6808,-5.5366 altitude : 1781m.
Colonizing the bare areas between the clumps of *Hammada scoparia* in a cemetery facing south in the upper valley of Wadi Todra.



20190419 Guers-Tiallaine gps : 32.2499,-4.2633 altitude : 1308m.
On the sandy soils of the pre-Saharan valley between Rich and Gourrama ; the reg areas of this valley are colonized by *Anabasis aretioides*. Note the flower stems over 2m tall !



20190328 Pays des dayas, à l'Est de Bouarfa gps : 32.5392,-1.5798 altitude : 1189m.

1.4 - Repartition of *Eruca* in eastern Morocco : **Contact *pinnatifida* / *foleyi***

The large wadi beds of Bouarfa and the Tamlelt plain constitute the southern limit of *Eruca pinnatifida* and the northern limit of *E. foleyi*. These two species coexist without forming a hybrid population.



20190328 N17-Bouarfa gps : 32.4837,-1.7730 altitude : 1142m.



20190328 N17-Bouarfa gps : 32.4837,-1.7730 altitude : 1142m.

1.5 - Repartition of *Eruca* in eastern Morocco : *Eruca foleyi* (Batt.) Perfectti

Eruca foleyi stands out with its blue flowers among other rockets. But to be sure that it belongs to the *Eruca* genus, all you need to do is bite into a leaf : its argula taste is even more pronounced than in species with yellow flowers.



20210402 Bouarfa-Tamlelt gps : 32.5024,-2.0402 altitude : 1081m.
It is not *Eruca foleyi* which is weed around the wheat plots, but on the contrary it is the wheat plots that have been sown inside an «Erucetum».



20190207 Fezna gps : 31.5156,-4.4397 altitude : 831m.
Magnificent station of *Eruca foleyi* in the sandy bed of an intermittent wadi which was flooded after a storm upstream.



20190207 Fezna gps : 31.5156,-4.4397 altitude : 831m.
The fleshy leaves of *Eruca foleyi* are picked to prepare cooked salads.
It is a traditional spring dish in Tafilalet.



20170213 Merzouga gps : 31.0551,-3.9893 altitude : 699m.

1.6 - Repartition of *Eruca* in eastern Morocco : **Contact *foleyi* / *aurea***

In Morocco *Eruca foleyi* reaches its southern limit at the latitude of Merzouga. It then comes into contact with *Eruca aurea* by forming magnificent mixed populations of crucifers in which *Diplotaxis virgata* (Cav.) DC and *Zahora aït-atta* Lemmel & M.Koch also participate. We have never found hybrid plants between these different taxa.



20190208 Khamlia gps : 30.9923,-3.9940 altitude : 686m.



20190312 Merzouga gps : 31.0838,-4.0685 altitude : 701m.

1.7 - Repartition of *Eruca* in eastern Morocco : *Eruca aurea* Battandier

We intentionally give a lot of photos of this species to show its importance in Saharan landscapes and its difference in morphology and ecology with *Eruca pinnatifida*.

All of these photos are taken in Tafilalet, but *Eruca aurea* has a very wide distribution. Towards the southwest we know large populations of them as far as the wadis of the oceanic Sahara, in the region of Smara. Towards the south-east it is attested in the central Algerian Sahara as far as Hoggar.



20190222 Ouzina gps : 30.7382,-4.2683 altitude : 636m.



20190222 Ouzina gps : 30.7382,-4.2683 altitude : 636m.



20190221 Tafraout-SidiAli gps : 30.6840,-4.7060 altitude : 647m.



20170216 Tafraoute-SidiAli-Tagounite gps : 30.6614,-4.7056 altitude : 644m.



20201229 Maider gps : 30.7928,-4.8351 altitude : 660m.
Rockets attract flocks of sheep from the North ...



20200226 Tafraout-SidiAli gps : 30.673, -4.690 altitude : 650m.
... and the herds of camels from the South !



20200226 Tafraout-SidiAli gps : 30.673, -4.690 altitude : 650m.
At the end of winter, transhumant beekeepers come from the north of Morocco to install their hives by the hundreds in the rocket fields.



20200226 Tafraout-SidiAli gps : 30.673, -4.690 altitude : 650m.

2 - Comparison of *Eruca pinnatifida* (Desf.) Pomel and *Eruca aurea* Batt.

Battandier had described *Eruca aurea* in 1900 ; he had not had time to incorporate it into his *Flore analytique et synoptique de l'Algérie et de la Tunisie* in 1902, but he introduced it in *Supplément aux Phanérogames de la Flore de l'Algérie* in 1910.

Battandier was not followed by his successors; between 1919 and 1950 this plant was successively named:

E. sativa (Garsault) var. *aurea* (Batt.) O.E. Schultz (1919)

E. pinnatifida var. *aurea* by Chevalier (1932)

E. sativa Lamk. ssp. *aurea* (Batt.) Maire (1933, 1940)

E. vesicaria ssp. *pinnatifida* var. *aurea* (Batt.) Maire (FAN)

And then this taxon was purely and simply ignored in all the following flora and becomes a «botanical ghost» : it is not mentioned by Quézel & Santa (1962) in «Nouvelle flore de l'Algérie et des régions désertiques méridionales», nor by Ozenda (1977-2004) in «Flore du Sahara», nor by Greuter & al. in «Med-Checklist» (1986), nor by Fennane & al. (1999-2014) in «Flore pratique du Maroc».

How to explain that one of the most spectacular plants of the flora of the Sahara could thus have been forgotten ?

We believe there are two reasons for this :

- Our predecessors mainly knew the *Eruca* through exsiccatas of young individuals ; at this stage all the species are more or less similar and it was easier for them to imagine having to deal only with subspecies of a single taxon. We have seen how the study of adult populations in the field leads to distinguish, on the contrary, different species.

- Saharan *Eruca* are found in areas grazed by herds or cultivated with cereals. Our predecessors who knew *Eruca sativa* as a species cultivated or escaped from cultivation in Europe deduced that it was the same in the Sahara (Chevalier 1932).

Ozenda writes for example about *E. [pinnatifida=] aurea* : «quite common in northern and central Sahara, especially in places frequented by herds» as if this species was a nitrophile growing where herds left their droppings. In reality, it is the opposite : it is not *Eruca* that grows where the herds have stayed, but the herds that come to nomadize where *Eruca* grows. The same goes for cereal crops ; *Eruca* is not a weed of cereals, it is the cereals that are cultivated in the wettest and least salty areas of «Erucastrum» !

So, let proceed to a meticulous morphological comparison of *Eruca pinnatifida* and *E. aurea* to validate the two Saharan *Eruca* of Battandier.

2.1 - Comparison of *Eruca pinnatifida* (Desf.) Pomel and *Eruca aurea* Batt. : **ecology & distribution**



To the left, *Eruca pinnatifida* is a plant from the transition zones between Mediterranean and Saharan vegetation.
In eastern Morocco, it is found in the south of the highlands of the Oriental in the last steppes covered with alfa.
In the eastern High Atlas, it can be found on arid southern slopes up to 1800m altitude.
It is particularly abundant in the Saharan piedmonts of the eastern High Atlas but does not venture into the Sahara itself.



To the right *Eruca aurea* is a plant of the Saharan wadis and maaders.
It has a very wide distribution.
Towards the southwest we know large populations of them as far as the wadis of the oceanic Sahara, in the region of Smara.
Towards the south-east it is attested in the central Algerian Sahara as far as Hoggar.



2.2 - Comparison of *Eruca pinnatifida* (Desf.) Pomel and *Eruca aurea* Batt. : **emerging leaf rosettes**



Eruca pinnatifida



Eruca aurea

These *Eruca* germinate just after the first rains in winter or early spring. They emit a first rosette of leaves and immediately a very early flowering stem. This adaptation is found in many annuals in arid and desert environments and makes it possible to produce at least a few seeds if the rain which made the seeds germinate is followed by a long arid period.

From the rosette stage the leaves have a characteristic argula taste and odor ; this taste and smell is reinforced when the leaves grow larger and then disappears when they dry out.

All the rosettes of yellow rockets look alike and are very difficult (or impossible) to tell.



Eruca aurea : This plant has just had time to emit a few flowers and a few siliques before an arid period dries up its basal rosette.

2.3 - Comparison of *Eruca pinnatifida* (Desf.) Pomel and *Eruca aurea* Batt. : **port**



Eruca pinnatifida : erected port



Eruca aurea : hemispherical port

The port is a good field criterion to distinguish the two lineages of yellow rockets.

2.4 - Comparison of *Eruca pinnatifida* (Desf.) Pomel and *Eruca aurea* Batt. : stems



Eruca pinnatifida : The stems are ramous only at the base, then straight. They are light green ; on 10 or 15cm at the base they are covered with long white hairs, then they are smooth and hairless over the rest of their height. Some keys give as a criterion that the stems of *E. pinnatifida* would be fistulous and easily crushed by squeezing them between the fingers. This criterion is inconstant.



Eruca aurea : The stems are very ramous. They can be thick, fistulous, glabrous and light green at the base, then thin, branched, more or less reddish or greenish in height.

2.5 - Comparison of *Eruca pinnatifida* (Desf.) Pomel and *Eruca aurea* Batt. : **basal leaves**



Eruca pinnatifida



Eruca aurea

The basal leaves are long, lanceolate or oblong.
Their cutouts are variable and do not constitute a
good criterion of identification.

2.6 - Comparison of *Eruca pinnatifida* (Desf.) Pomel and *Eruca aurea* Batt. : **stem leaves**



Eruca pinnatifida : there are a few short caulinary leaves applied to the base of the stem.



Eruca aurea : caulinary leaves can take extensive development and replace basal leaves which wither under their shade.

Stem leaves are a better criterion of identification than basal leaves.

2.7 - Comparison of *Eruca pinnatifida* (Desf.) Pomel and *Eruca aurea* Batt. : **flowering tops**



Eruca pinnatifida is distinguished by its long flowering clusters with a cluster of not yet open buds that dominate the open flowers.



Eruca aurea : the terminal buds are hidden behind the last blooming flowers.

The structure of the flowering top is a good field criterion to distinguish the two lineages of yellow rockets.

2.8 - Comparison of *Eruca pinnatifida* (Desf.) Pomel and *Eruca aurea* Batt. : **calyx & corolla**



Eruca pinnatifida



Eruca aurea

The calyxes and corollas of the yellow rockets are very similar. The petals are veined by a network of purple or brown vessels ; this is one of the characteristics of the *Eruca* genus.

2.9 - Comparison of *Eruca pinnatifida* (Desf.) Pomel and *Eruca aurea* Batt. : **fruiting stems**



Eruca pinnatifida : the siliques are shortly spaced.

In the *Eruca* genus, as most often in *Brassicaceae*, it is the fruiting stems and the morphology of the seeds which allow the most precise identifications.

But beware ! In the *Eruca* genus the siliques do not ripen as long as the stem continues to emit flower buds. We therefore find at the top of the stems, just under the flowers, small siliques barely larger than the ovary of the flower, then on descending increasingly long siliques, but of which even the lowest have not yet completed their growth.

During this growth the relative dimensions of the peduncle, the valve part and the rostrum vary constantly. All the old keys of identification based on the dimensions of the siliques then lead to the «chaotic» results.

Stems with flowers and siliques are rich in information, but should be used with care. The morphology of siliques and seeds can only be validly studied on dry stems when the mature siliques begin to open spontaneously.



Eruca aurea : the siliques are more widely spaced.

2.10 - Comparison of *Eruca pinnatifida* (Desf.) Pomel and *Eruca aurea* Batt. : **siliques**



Eruca pinnatifida : the length of the rostrum is variable : usually less than the half of the length of the valves.



Eruca aurea : the length of the rostrum is variable : usually more than the half of the length of the valves, up to twice the length of the valves.
The red color of the pods of *Eruca aurea* in the photo above is not characteristic.
The siliques of *Eruca aurea* can be beige like those of *E. pinnatifida* in the photo on the left

2.11 - Comparison of *Eruca pinnatifida* (Desf.) Pomel and *Eruca aurea* Batt. : seeds



Eruca pinnatifida : the seeds are small (between 0.8 and 1.2mm). They are more or less ovoid, usually yellow. They are numerous (more than 40 for each valve).



Eruca aurea : the seeds are much bigger (between 1.4 and 2mm). They are flattened, more or less lenticular, surrounded by a narrow wing (0.1 to 0.2mm wide), usually brown. They are not numerous (less than 20 for each valve).

The size and form of the seeds are the best criterion to distinguish not only *E. pinnatifida* and *E. aurea*, but also -according to us- to characterize their lineages.

3 - Identification key of *Eruca* in the western Palearctic

By their flowers the rockets belong to the *Brassicaceae* family.

By their siliques the rockets belong to the *Brassicaceae* tribe.

Linnaeus had classified rockets in a broad genus *Brassica*. According Al-Shehbaz (2012) this genus has been too dismembered and a future revision of *Brassicaceae* will perhaps lead to reincorporate inside *Brassica* a large number of related genera.

Linnaeus' successors have classified «true rockets» in the *Eruca* genus.

We can define *Eruca* by the following characters :

- the leaves have a characteristic argula smell and taste
- the flowers, yellow or blue, are veined by a network of purple or brown vessels
- the siliques have a valvar part (short and ovoid or long and cylindrical) and a stylar part in the shape of a triangular rostrum, devoid of seed (this rostrum can be much shorter than the valvar part or up to 2 times as long)

By adding the two taxa described by Linnaeus (*sativa* & *vesicaria*), with a taxon described from Spain (*longirostris*) and three taxa described from North Africa (*pinnatifida*, *aurea* & *foleyi*) we get six taxa for the western Palearctic.

In the state of current knowledge, these six taxa must be treated as so many species, even if the morphology shows similarities between some of them, similarities which we cannot say today if they result from phylogenetic proximity or convergent adaptations.

1. flower color ?

- blue flowers ; fleshy, glaucous-green leaves
=> *Eruca foleyi* (Batt.) Perfectti
- white or yellow flowers ; thinner leaves, bright green
=> **2**

2. port, stems & seeds ?

- erect port ; stems sparsely branched, sparsely leafy, ending in a cluster of flower buds clearly exceeding open flowers ; seeds small (about 1mm), ovoid, yellowish, numerous (≥ 40 per valve)
=> **3**
- hemispherical port ; stems branched, leafy, ending in flower buds hidden under open flowers ; seeds fairly large (≥ 1.5 mm), lenticular, with a fine wing, brownish, few in number (≤ 20 per valve)
=> **4**

3. chorology [erect port] ?

- wild plant found in arid zones and the Saharan borders of North Africa
=> *Eruca pinnatifida* (Desf.) Pomel
- cultivated or weed plant, initially in Europe and Asia, today worldwide
=> *Eruca sativa* (L.) Miller

4. chorology, silique [hemispherical port] ?

- plants around the Mediterranean basin ; silique with deciduous calyx, hairy valves, rostrum longer than half of the valves
=> *Eruca longirostris* Uechtr.
- plant locally present in islets within populations of *Eruca longirostris* but distinguished by its calyx adhering to the silique
=> *Eruca vesicaria* (L.) Cav.
- Saharan plants ; silique with deciduous calyx, with smooth valves, with a rostrum shorter than the valves
=> *Eruca aurea* Batt.

3.1 - *Eruca sativa* (L.) Miller

in Gard. Dict. ed. 8: n.º 1, 1768.

≡ *Brassica eruca* L. in Sp. Pl: 667, 1753.

Type : Herb. Linn. No. 844.18 (LINN) (lectotype designated in Cafferty S. & Jarvis C.E., Taxon 51 :531, 2002)

Garden rocket is a plant cultivated in the Mediterranean world from antiquity until today ; its leaves are eaten as salads ; the seeds are used for their medicinal properties or to produce oil.

It is often called *Eruca vesicaria* subsp. *sativa*. This name originate in a fantasy of Thellung (1919) and was erroneously kept by most flora until today.

From its description by Linnaeus under *Brassica eruca* this species is well characterized morphologically :

- basal leaves cut out, ending in a large lobe
- erect habit
- floral stems ending in a small cluster of unbloomed buds
- caducous calyx
- hairless silique with a beak shorter than half of the valves



Exsiccata 844-18 from Linnaeus' herbarium



Detail of silique from Linnaeus' herbarium



Eruca sativa as a weed in Montpellier (France)
By its habit and morphology this plant is very close to the wild *E. pinnatifida* from North Africa

3.2 - *Eruca vesicaria* (L.) Cav.

in Descr. Pl.: 426, 1802

≡ *Brassica vesicaria* L. in Sp. Pl. 668, 1753.

Type: Herb. Linn. No. 844.20 (LINN) (lectotype designed in Cafferty S. & Jarvis C.E., 2002 : 532)

Eruca vesicaria is a rare species, limited to three small areas of Spain, Morocco and Algeria and perfectly described by Linnaeus under *Brassica vesicaria*.

This rocket is immediately distinguished from *Eruca sativa* by the shape of its leaves and by the calyx which remains adherent around the silique.

Sobrino-Vesperinas E. (1995) «Infertilidad entre *Eruca vesicaria* y *E. sativa*» performed experimental hybridizations between these taxa.

The crossing *E. sativa* female x *E. vesicaria* male shows pollen fertility reduced by 64% ; seeds are generated in small numbers and give rise to a few viable hybrids ; the fertility of these hybrids has not been tested.

The crossing *E. vesicaria* female x *E. sativa* male generates few seeds and these seeds are sterile.

Sobrino-Vesperinas then decides : «Taking into account the existence of some morphological differences and the partial reproductive barriers, we consider as a correct taxonomic treatment the maintenance of the specific level for both taxons.»



Exsiccata 844-21 from Linnaeus' herbarium



Plant photographed near Safi (Morocco)



Detail of silique from Linnaeus' herbarium



Detail of the same (Photos A. Homrani-Bakali)

3.3 - *Eruca pinnatifida* (Desf.) Pomel.

in Nouv. Mat. Fl. Atl. : 367, 1875.

≡ *Brassica pinnatifida* Desf. in Fl. Atlant. t.2: 95, 1795.

Type: [P] herbarium Desf. Not scanned.

Maire in the «Flore de l'Afrique du Nord» gives the following description : «Usually tall, robust grass, up to 1 m in height, with pruinose stems, hollow, easily compressible. Basal leaves in a long persistent rosette, usually large (up to 45 cm long.), pinnately-parted, with spaced segments, ± sinuous-lobulated or sinuous-dentate, the terminal often smaller or slightly larger than the laterals; peduncles fairly long, reaching 1/2 the length of the silique ; siliques glabrous, with oblong, swollen valve part ; valves not very leathery, keeled ; rostrum shorter than the valves. Ovary 40-60-ovulate. Seeds small, c. 1 mm long, clearly biseriate».

We can add to this description the following details:

- the height is usually 1m, but can reach 2m in a rainy season
- the compressible character of the stems is inconstant
- the stems are glabrous except in their lower part where they are covered with long white hairs
- the flowers then the pods are closely spaced ; a long stem can have a hundred of them
- flowering stems are typically terminated by a cluster of unbloomed flower buds



Planche extraite de 'Flora atlantica, illustrationes' Desf. 1799



20190327 151313_N10-Tamlelt - gps: 2.3739,-2.2116 - alt.1034m.

3.4 - *Eruca longirostris* Uechtr.

in Oesterr. Bot. Z. :136, 1874,

Type ???

Icon : Ill. Flor. Hispaniae Tab. LIX, 1881-85.

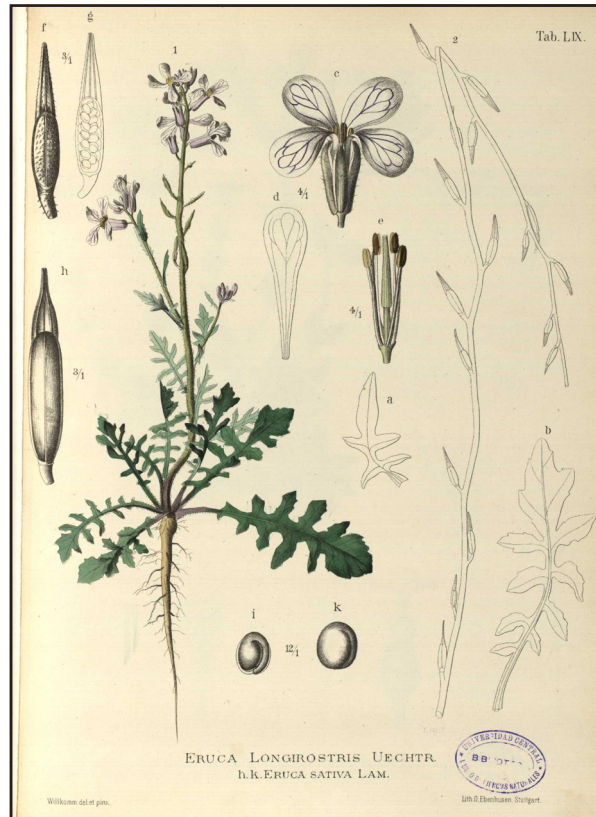
Eruca longirostris has been described by Uechtritz (Oesterr. bot. Zeitschr. 1874, p. 136 and 1875, p. 409) ; the Latin diagnosis was given by Willkomm in *Prodomus florae hispanicae* (1880, vol.3 p. 849) then in *Illustrationes florae Hispaniae insularumque Balearium* (1881-1885, p. . 92, Tab. LIX).

Eruca longirostris is widespread all around the Mediterranean Basin ; it is attested from Spain, Morocco, Algeria, Tunisia, Libya, Turkey, Greece...

Despite this large distribution, there was such confusions within the genus *Eruca* that it has been erroneously treated as a synonym of *Eruca sativa* or a subspecies of *Eruca vesicaria* or ignored by the majority of flora to become an other «ghost species».

Thus Gomez-Campo in *Flora iberica* recognizes only *Eruca vesicaria* by explaining: «*The polymorphism of this species is very marked, but the characteristics that have been used in the description of intraspecific variability are very inconsistent ... When this characteristic is considered in dry plants, the observations depend to a great extent on the moment in which the plant was herbalized; consequently, infraspecific determinations based on such a character are truly chaotic ...* ».

Chaotic in herbarium, may be. But not so difficult in the field !



This excellent plate by Willkomm gives an accurate and complete description of *Eruca longirostris* and a precise comparison of its silique and seed with those of *E. sativa* (details h & k).



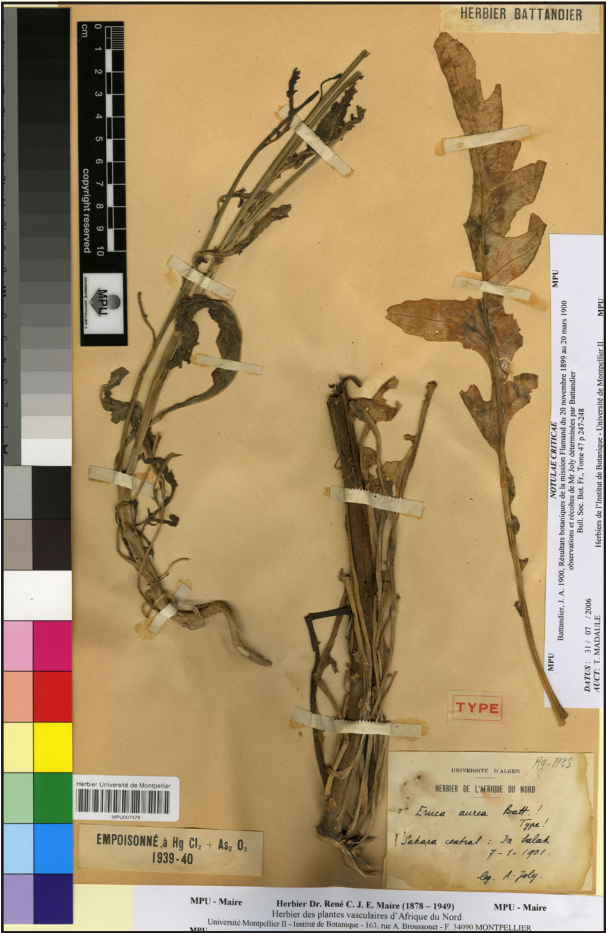
The siliques and seeds are characteristic



3.5 - *Eruca aurea* Batt.

in Bull. Soc. Bot. France 47: 247, 1900.

Typus : Algérie : Sahara central. In Salah, 7.1.1901, Joly (holo[MPU007376], iso [P00166900])



MPU007376 TYPE

248

SÉANCE DU 27 JUILLET 1900.

***Eruca aurea* nov. sp. — Plante annuelle, puissante. Tige et inflorescence hispides à poils réclinés; feuilles grandes, glabrescentes, atténuées en pétiole, étalées-dressées, profondément sinuées, à lobes ordinairement lancéolés-aigus, même le terminal; lobes latéraux se détachant du rachis à angle aigu; sépales dressés hispides, peu gibbeux; fleurs grandes, jaunes, veinées de violet, pétales à limbe un peu plus court que dans l'*E. sativa* L. mais de même forme; pédicelle florifère plus court que le calice; siliques peu indurées, glabres, rougeâtres, très renflées, à bec lancéolé un peu plus court que les valves et égalant le pédicelle fructifère. — Décembre-janvier. Oued Inçokki, In Salah.**

Plante remarquable par ses fleurs jaunes et son feuillage rappelant en plus grand le *Diplotaxis tenuifolia*, néanmoins voisine de l'*Eruca sativa* L.



MPU007378 COTYPE



20190304 - Smara - gps: 27.0489,-11.1517 - altitude: 196m.

3.6 - *Eruca foleyi* (Batt.) Perfectti

in PeerJ 5: e3964, 2017

≡ *Moricandia foleyi* Batt. in Bull. Soc. Bot. France 61: 52, 1914.

Holotype : Algérie, Sud oranais : Nebkas dans les vallées de l'oued Namous et de la Zousfana, mars-avril 1913, Foley sn. ([MPU006516] image!)

This magnificent plant was described by Battandier as *Moricandia foleyi*. From the first moments, Battandier had noticed that «it constitutes in the genus *Moricandia* a type quite apart». So much apart that the morphology of its silique should never have classified it as *Moricandia*. But Maire, then a very young botanist, did not question this determination, neither by co-signing this opus with the old master, nor later in his «Flore de l'Afrique du Nord».

The first alert came in 2015 when Zahora refused to admit that this plant could be a «cousin» of *Moricandia suffruticosa* and claimed that this plant was a *tazakht* (= a rocket in Tamazight) : «your book (the «Flore du Sahara» of Ozenda) is wrong ; you only have to taste it or smell it to know, it is obvious, and besides, it is very good to eat as a cooked salad....»

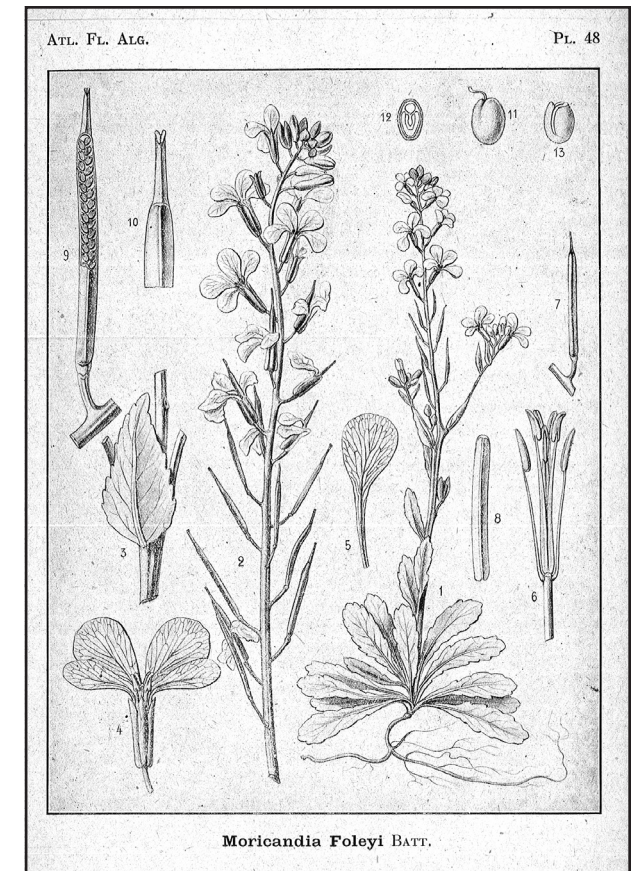
The port of *X foleyi* was going well in the direction of Zahora, but was that enough to privilege the ancestral culinary knowledge of Aït-Atta to a century of botanical knowledge ?

A first strong argument was found in «Guide to Wild Germplasm of Brassica and Allied Crops» : Warwick (2009) had compiled the chromosome numbers of the Brassicaceae and established that *Moricandia foleyi* had 11 pairs of chromosomes, like the *Eruca*, while the other *Moricandia* had 14.

The coup de grace was given by Perfectti (2017) who in his genetic revision of *Moricandia* establishes that *foleyi* was in fact an *Eruca*.



Zahora picking of *Eruca foleyi* for exsiccatae-
tazakht for the evening meal.



Battandier, 1920 - Atlas de la flore d'Algérie.
Iconographie avec diagnoses d'espèces nouvelles,
inédites ou critiques de la Flore Atlantique - Pl. 48

Discussion - How to (in)validate phylogenetically the results of the morphological study?

We are aware of two genetic studies on *Eruca* :

- S. I. Warwick, R. K. Gugel, C. Gomez-Campo and T. James, 2007 - Genetic variation in *Eruca vesicaria* (L.) Cav.
- Plant Genetic Resources: Characterization and Utilization 5(3); 142–153 ; C. Egea-Gilabert et al., 2009 - Genetic variability in wild vs. cultivated *Eruca vesicaria* populations - Scientia Horticulturae 121 (2009) 260–266).

These studies make it possible to differentiate taxa within *Eruca* but, given the confusion reigning in this genus, we do not know what covers in these studies the Spanish “vesicaria” (*vesicaria*, *sativa*, *longirostris* ?) nor the Moroccan “sativa” (*sativa*, *longirostris* ?), nor the Moroccan “pinnatifida” (*pinnatifida*, *aurea* ?) as quoted in these articles.

It therefore seems essential to us to carry out a genetic study of *Eruca* on the basis of samples taken from the heart of the most stable populations and unambiguously identified morphologically by exsiccatas.

E. foleyi is known from the Perfectti’s revision of Moricandia.

E. sativa is genetically well known from agronomical studies.

E. pinnatifida must be sampled from Gafsa in Tunisia or from the Saharan Atlas in Morocco.

E. longirostris must be sampled from Andalucia and NE Morocco.

E. vesicaria must be sampled from Central Spain, Safi in Morocco and Oran in Algeria.

E. aurea must be sampled from the Tafilalet in Morocco or the Central Sahara in Algeria.

Among the question that a genetic study should answer :

- morphology suggest that erect port and small seeds (shared by *E. foleyi* and *E. pinnatifida*) are ancestral characters. True or false ?
- morphology suggest that *E. pinnatifida* is the wild ancestor of *E. sativa*. True or false ?
- morphology suggest that hemispherical port and big winged seeds (shared by *E. longirostris* and *E. aurea*) are recent mutations in *Eruca*. True or false ?
- morphology and repartition suggest that *E. vesicaria* is a neotenic variation of *E. longirostris* in gypseous soils. True or false ? Does this variation appears once or 3 times ?

Eruca aurea deserves to be recognized and studied by agronomists. It is a prolific species by its leaves and by its seeds. It is adapted to desert climates, salty soils and haphazard water resources.

It could perhaps play a role either as such in the rehabilitation of uncultivated soils in arid or Saharan climates, or in crosses with other cultivated *Brassicaceae*.

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