



ORIGINAL ARTICLE

Morphological Taxonomy of the Genus *Lathyrus* (Papilionaceae) in Kurdistan-Iraq

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ABSTRACT

A comparative systematic study of morphological characters was carried out for eighteen species belong to the genus *Lathyrus*, family Papilionaceae in Kurdistan-Iraq during 2010-2013 seasons. The studied characters were for duration and habitat, leaves, inflorescences, flowers, fruit and seeds. Phytogeographic districts were surveyed to detect the distribution of the studied species, large numbers of specimens were collected; those from herbaria of Kurdistan region were studied also in addition to Flora of Iraq part No.3 and each of Flora of Iran and Turkey. This study indicates that the characteristics of leaf, inflorescence, flower, fruit and seed were collectively contributed in the separation and identification of the studied taxa. Characters, calyx, corolla and pods were found to be the most stables. As a result, all the taxa of this genus *Lathyrus* were fully described for the first time conducted on Iraqi specimens.

Key words: Morphology, *Lathyrus*, Papilionaceae, phytogeographic, Taxa

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INTRODUCTION

Lathyrus L. species are well placed to meet the increasing global demand for food and animal feed, at the time of climate change. The plants of the genus *Lathyrus* L. are legume crops of economic and ecological significance in several countries in the world [1-7]. *Lathyrus* is the largest genus in tribe Viciae and has an importance as traditional foodstuffs in many cultures worldwide [8]. It is a very popular crop in many Asian and African countries where it is grown either for stock feed or human consumption. The seeds of grass pea (*Lathyrus sativus* L.) are rich in crude protein (24.31%) and complement cereals in amino acid composition for a balanced diet of poor people in its major production zones [9-11]. It is grown mainly for food in Indian region and Ethiopia, and for feed and fodder in other countries [5, 6, 3]. The use of this genus in rotation with cereals is encouraged in West Asian and Australian dry areas [12, 11]. Its cultivation is also encouraged in countries of both North and South America, Australia and Southern Europe to adapt to the adverse effects of climate change and to break the wheat cultivation practice [13-18].

The genus *Lathyrus* is a member of the Viciae tribe (family Papilionaceae). *Lathyrus* contains some 160 species [19] distributed throughout temperate regions of the northern hemisphere and extends into tropical E. Africa and into South America. In Iraq, the genus *Lathyrus* is represented by 18 species which are separated into 8 sections based on morphological traits [20]. Some species such as *L. sativus*, *L. cicera*, *L. odoratus* have agricultural importance as forage, fodder or ornamental plants and have long history as cultivated plants.

Morphological characterization will be performed to study the diversity of the genus *Lathyrus*. The study will result in a better understanding of *Lathyrus* taxonomy and the relationships among taxa in Kurdistan of Iraq.

MATERIALS AND METHODS

About 200 specimens for the *Lathyrus* species have been collected during the seasons 2010-2013 in different areas of Kurdistan-Iraq, at the rate of more than 30 field trips. During each season at least 3 visits were done for each location to take field samples and the collection of information in different stages of vegetative, floral and fruit parts. A special record has been organized to register field

information for each taxa including number, date and site of collection of specimens ,on the environments of collected samples ,and altitude. Detailed study of each sample has been conducted concerning morphological aspects for 17 local species and an introduced species *L.odoratus*.

RESULTS

Habitat and Duration

The plants of the genus *Lathyrus* distributed in Kurdistan-Iraq , as it is indicated in the table (1) are herbs and annual except *L.rotundifolius* , *L. boissiere* and *L. pratensis* which they are perennial .

Root System

The roots of the species of genus *Lathyrus* are characterized by cylindrical tap root system. Due to difficulty of measuring of the characters of root, it has the least important classification.

Stem

The type of the stem of studied species is indicated in the table(1) as the following:

- 1.Species with erect stems in *Lathyrus nissolia* , *L.bijugus* and *L.boissieri* .
- 2.Species with erect or decumbent stems in *L.sphaericus* ,*L.inconspicuus* and *L.vinealis*.
- 3.Species with scrambling or diffuse stems in the rest of the taxa under study.

Through the direct field measurement of the stem length, the following groups were observed:

- 1.Species with stem length not exceed 50 cm as in *L.aphaca* , *L.inconspicuus* , *L.ochrus* , *L.cicera* , *L.bijugus* , *L.sphaericus* and *L.vinealis*.
- 2.Species with stem 50–80 cm long as in *L.nissolia* , *L.sativus* , *L.gorgoni* , *L.cassius* and *L.boissieri*.
- 3.Species with stem length exceed 100 cm as in the rest of studied species.

With respect to the stem section of the studied species , they are as the following :

- 1.Species with cylindrical stem section in *L.aphaca* , *L.sphaericus* and *L.inconspicuus*.
- 2.Species with angular stem section in *L.nissolia* , *L.boissieri* and *L.vinealis*.
- 3.Species with angular and winged section of the stem completely or above of it as in the rest of studied species.

According to the indumentums for stems, the following groups were detected:

- 1.The stem is furnished moderately with long tuberculate-based hairs in the species *L.odoratus*.
- 2.The stem is covered in dense, soft and spreading hairs in the species *L.chloranthus*.
3. The stem is semi-glabrous or moderately appressed hairy in the species *L.pratensis*.
4. The stem is glabrous almost , rarely pilose or sparingly hairy in the rest of studied species.

Leaves

The leaves of studied species are usually pinnately reticulate veined and alternately arranged on the stem.Their characters of the studied species of genus *Lathyrus* are shown in the tables(2)and(3).

Stipules

The current study has showed the following groups of the species regarding the length of stipules:

- 1.The stipules are minute in the species *Lathyrus nissolia*.
- 2.The average length of stipules is not exceeded 15 mm in the species *L.ochrus* , *L.bijugus* , *L.cassius* , *L.hirsutus* , *L.chloranthus* , *L.boissieri* and *L.inconspicuus*.
- 3.The length of stipules is exceeded 15 mm upto 40 mmm as the average in the rest of species.

The shape of stipule is also contributed in the isolation of species to the following groups:

- 1.Stipules in the species *L.aphaca* are fallacious with ovate- hastate shape.
2. Stipules shape in the species *L.nissolia* is filiform .
- 3.Stipules shape in the species *L. ochrus* ,*L.cicera* , *L.gorgoni* , *L.odoratus* , *L.rotandifolius* and *L.pratensis* is semi-hastate.
4. Stipules shape in the rest of species is semi-saggitate.

Leaf petiole

The length of leaf petiole has attributed in isolation the taxa under study as the following :

- 1.The leaves of the species *Lathyrus aphaca* ,*L. nissolia* , *L.ochrus* and *L.boissieri* are sessile.
- 2.Short petiole 3–10mm in the species *L.cicera* , *L.sphaericus* , *L.inconspicuus* and *L.vinealis* .
3. The leaves of rest of species are Longley petiolate 10– 40 mm.

The species can also divided depending on the presence of wing's petiole into two groups the first group lacks wings on leaf 's petiole in *L. sphaericus* , *L.inconspicuus* , *L.vinealis* and *L.pratensis* , while the other studied species have winged leaf petiole Rachis

It represents the axis that carrying the leaflets. The type of modification of termination of leaf rachis is also varied between the species under study which can be arranged as the following:

- 1.Tendril is absent in the species *L.nissolia* .
2. Arista with 4–8 mm length in the species *L.boissieri* .

3. Long , short conspicuous or distinct cusp, or simple or branched tendril system in the species *L. sphaericus* , *L.inconspicuus* and *L.vinealis* .
4. Simple or branched prehensile or very prehensile tendril in the rest of studied species.

Leaflets

According to the leaf type , the studied species are arranged in the following groups:

1. Imparipinnate leaf type in the species *Lathyrus bijugus*.
- 2.Reduced to narrow, grass-like phyllodes in the species *L.nissolia*.
- 3.Reduced to a simple tendril in the species *L.aphaca*.
4. The lower leaves of the species *L.ochrus* are simple and the uppers with 1-2(-3) pairs of leaflets.
- 5.Species with paripinnate leaf type with 1-2 pairs of leaflets in *L.boissieri* and *L.vinealis*.
- 6.The rest of studied species has also paripinnate leaf type but only with 1 pair of leaflets.

In terms of the leaflets shape , the leaflets are reduced to tendril in the species *L.aphaca* and the other species are distributed into two groups the first is with broad leaflet type of ovate, elliptic , oblong or obovate shapes in *L.ochrus*, *L.chloranthus*, *L.odoratus* and *L.rotundifolius* ; while the rest of species are with narrow leaflet type of lanceolate , linear, linear oblong ,elliptic lanceolate and narrowly elliptic-lanceolate or narrow grass-like phyllodes shapes . The leaflet area is another data that is used in classifying the studied species as the following:

- 1.Species with leaflet area between 100 – 250 mm² as average in *L.sativus* , *L.cicera* , *L.gorgoni* , *L.annuus*, *L.cassius*, *L.sphaericus*, *L.inconspicuus* , *L.vinealis* and *L.pratensis*.
2. Species with leaflet area are between 500 – 1000 mm² as average in *L.nissolia* , *L.ochrus* , *L.bijugus* , *L.hirsutus* , *L.chloranthus* and *L.odoratus*.
- 3.Lefflet area in both species *L.rotundifolius* and *L.boissieri* between 1500 – 1750 mm² as average.

Flowers

Flower and calyx characters of the studied species of genus *Lathyrus* are shown in the tables (4) and (5) respectively, and figure(1). The flowers of the species under study are axillary , perfect and zygomorphic , and arranged in the following inflorescence systems:

- 1.Simple racemes of 1-2(-3-4) flowers in the species *L.nissolia* , *L.ochrus*, *L.annuus*, *L.cassius*, *L.hirsutus* , and *L.odoratus* .
2. Simple dense racemes of 3-12 flowers in the species *L.rotundifolius* , *L.boissieri* and *L.pratensis* .
3. Solitary flowers, very rarely 2 flowers in the rest of the studied species.

The colour of flowers ,as it is shown in the figure(1) is a distinguished character of plant morphology that used in isolating the following groups of species:

- 1.Yellow or creamy flowers group:Yellow or creamy flowers in *L.aphaca*, white or creamy in *L.ochrus*, yellow to pinkish in *L.annuus* and yellow, standard with a few darker streaks in *L.pratensis* and pale greenish yellow in *L.chloranthus* .
- 2.Crimson-pink- deep rose flowers group: Crimson flowers in the species *L.nissolia* and *L. sphaericus* or standard is crimson and wings are bluish in *L.hirsutus* or the flower is deep pink to crimson in the species *L.vinealis* or pink in *L.cassius* and deep rose in the species *L.gorgoni*.
- 3.Red-orange flowers group: Flowers are Brick red to salmon pink or purplish in the species *L.cicera* or standard and wings are orange-red, and keel is yellowish in the species *L. rotundifolius* .
- 4.Bluish-lilac flowers group: Sky purplish-blue standard and wings , and keel is paler in *L.sativus*;bluish flowers in the species *L.bijugus* or standard is pale blue or lilac other are paler in the species *L.inconspicuus* ;and lilac to magenta violet in the species *L.boissieri*.
- 5.The species *L.odoratus* with various colours of the flowers; blue, red , yellow or white.

The calyx /corolla length is used also to isolate the studied species to groups as the following:

- 1.The length of calyx is slightly exceeded that of corolla in the species *Lathyrus aphaca*.
- 2.The calyx length is about 1.5-2.0 or twice that of corolla in the species *L.nissolia* , *L. sphaericus* , *L. cicera*, *L.bijugus*, *L.hirsutus*, *L.ochrus* and *L.vinealis*.
- 3.The rest of *Lathyrus* species under study with calyx length more than 2-3 of corolla length.

Peduncle

The peduncle linking the flower to the stem .The ratio of length of flower's peduncle to leaf's petiole has contribution in isolation the taxa under study as the following :

- 1.The flower's peduncle is longer than leaf's petiole about 1/4 in the species *Lathyrus inconspicuus*.
- 2.The flower's peduncle is equal or slightly longer than leaf petiole in the species *L. sativus* , *L.cicera* and *L.sphaericus*.
3. The ratio of flower's peduncle to leaf petiole much exceeds as the leaves of species *L.aphaca* ,*L. nissolia* , *L.ochrus* and *L.boissieri* are sessile.
- 4.The flower's peduncle are longer than leaf petiole 2- 6 in the rest of species under study .

The permanence of bract has an observable role in distributing the species under study on two groups, the first one includes the species with caducous bracts in *L. sativus*, *L. cicera*, *L. chloranthus*, *L. gorgoni*, *L. odoratus*, *L. vinealis* and *L. pratensis*, while the rest of species have permanent bract.

Calyx

Floral calyx of *Lathyrus* genus is green to light green coloured, synsepalous of five parts consisting the calyx tube and calyx limb with five teeth. The teeth lengths are different depending on the species, as two types of the calyx are distinguished in this study, the first is irregular as the upper pair of teeth are shorter than the lower three in the species *L. nissolia*, *L. sativus*, *L. rotundifolius*, *L. boissieri* and *L. pratensis*; while the rest of species with regular or semi-irregular. The calyx shape has shown diversity among the taxa under study, as the following shapes are observed:

1. The conical shape of the calyx in the species *L. aphaca*.
 2. The straight or tubular shape of the calyx in the species *L. pratensis*.
 3. The tubular-campanulate shape of the calyx in the species *L. inconspicuus*.
 4. The rest of species under study have the campanulate shape of their calyx.
- The future of outer and inner surface of the calyx has also contribution in the classification process of the studied taxa, where the following variations were detected:
1. The calyx of the species *L. cassius* is furnished in and out with sessile glands.
 2. The calyx of the species *L. chloranthus* is densely hairy or somewhat glandular.
 3. The calyx of the species *L. odoratus* is flexuose-hairy.
 4. The calyx of the species *L. pratensis* is appressed hairy.
 5. Generally the calyx is glabrous, sparsely glandular in the species *L. sativus*, *L. cicera*, *L. hirsutus* and *L. gorgoni*; or thinly hairy in *L. inconspicuus*; 2-3 celled glands within in *L. annuus* and the teeth are ciliate in *L. boissieri* and *L. vinealis*.
 6. The rest of species have almost glabrous calyx but without observed epidermal characterizes.

The teeth shape has importance in isolating the species under study to the following groups:

1. The shape of calyx teeth is broadly or normally deltoid-lanceolate in the species *L. annuus*, *L. cassius*, *L. hirsutus*, *L. rotundifolius* and *L. boissieri*.
 2. The shape of calyx teeth is lanceolate-acuminate in the species *L. chloranthus*.
 3. The shape of calyx teeth is lanceolate in the species *L. aphaca*, *L. gorgoni*, *L. odoratus*, *L. bijugus* and *L. ochrus*.
 4. The shape of calyx teeth is lanceolate-subulate in the species *L. cicera* and *L. pratensis*.
 5. The rest of species under study have subulate teeth shape of their calyx.
- The teeth length /calyx tube was used as taxonomical tool, as the following states were measured:
1. The teeth are longer than the tube (1.5)–2.0–3.0 times in the species *L. aphaca*, *L. sativus*, *L. cicera*, *L. gorgoni*, *L. chloranthus*, *L. odoratus* and *L. sphaericus*.
 2. The teeth are shorter than the tube at most 0.50–0.75 times in the species *L. rotundifolius*, *L. boissieri* and *L. pratensis*.
 3. The teeth are equal or sub-equal the tube in the rest of studied species.

Corolla

Corolla in the studied species is papilionaceous type consists of five petals, the outer one is wide namely Standard, the two collateral petals are smaller namely Wings while the inner two are adnate namely Keel. According to the petals dimensions, as it is indicated in the table(6) three groups of flower size of the studied species are observed which they are:

1. Species have small flowers with dimensions of each of standard 7–13 mm, wings 5–11mm and keel 5–10 mm in *Lathyrus aphaca*, *L. cicera*, *L. bijugus*, *L. sphaericus*, *L. inconspicuus* and *L. vinealis*.
2. The species *L. odoratus* has large flowers with dimensions of each of standard 20–30 mm, wings 18–25 mm and keel 15–20 mm.
3. The rest of the studied species have medium size of flowers.

The shape of flower petals also shows variation, as it is clear in the table(6), which depending on the standard shape, the following groups of *Lathyrus* studied species were isolated:

1. Standard has obcordate shape in the species *L. sativus*, *L. cicera*, *L. gorgoni* and *L. bijugus*.
2. Standard has broadly obovate shape in the species *L. annuus*, *L. cassius* and *L. chloranthus*.
3. Standard has obovate shape in the species *L. sphaericus* and *L. vinealis*.
4. Standard has curved obovate-spathulate shape in the species *L. boissieri*.
5. Standard shape is broadly ovate - oval in the species *L. pratensis*.
6. The rest of the studied species have obovate-spathulate shape.

Depending on the wings shape the following groups of *Lathyrus* studied species were isolated:

1. The shape of wings is broadly obovate in the species *L. ochrus*, *L. sativus*, *L. cicera*, *L. bijugus* and *L. annuus*.
2. The shape of wings is narrowly oblong in the species *L. gorgoni*.

3. The shape of wings is oblong curved in the species *L.hirsutus*.
 4. The shape of wings is oblong in the species *L.chloranthus*.
 5. The shape of wings is very broadly ovate in the species *L.odoratus*.
 6. The shape of wings is oblong-obovate in the species *L.boissieri*.
 7. The shape of wings is obovate-oblong in the species *L.pratensis*.
 8. The rest of the studied species have obovate shape.
- Regarding the shape of Keel the following groups of *Lathyrus* studied species were isolated:
1. Oblong keel in the species *L.aphaca*, *L.nissolia*, *L.chloranthus*, *L.inconspicuus* and *L.vinealis*.
 2. Deltoid Keel group in the species *L.annuus*, *L.cassius*, *L.rotundifolius*,
 3. Keel shape is deltoid-subquadrate in the species *L.hirsutus*.
 4. Keel shape is oblique obtuse in the species *L.bijugus*.
 5. Keel shape is falcate incurved in the species *L.boissieri* and falcate-oblong in the species *L.pratensis*.
 6. The rest of the studied species has deltoid-oblong or broadly deltoid-oblong or oblique deltoid-oblong keel shape.

Androecium

The stamens of *Lathyrus* are diadelphous. No observed differences of Androecium were detected.

Gynoecium

The female reproductive organ of the genus *Lathyrus* as the other taxa of the family Papilionaceae consists of a monocarpel simple pistil in 3 parts stigma, style and ovary.

Stigma

No observed differences of stigma were detected among the studied species.

Style

The style shape is varied, as it is indicated in the table(7) to the following groups:

1. The style is straight dorsally compressed in the species *L.aphaca*, *L.nissolia* and *L.boissieri*.
2. The style is much compressed and spatulated in the species *L.hirsutus* and *L.inconspicuus*.
3. The style is narrowly winged above in the species *L.odoratus*.
4. The style is contorted dorsally compressed in the species *L.chloranthus* and *L.rotundifolius*.
5. The style is contorted ventrally compressed in the species *L.sativus*.
6. The style is spatulated at the apex in the species *L.gorgoni*.
7. The style is expanded straight near the apex in the species *L.vinealis*.
8. The style is shortly dilated and spatulated above in the species *L.sphaericus*.
9. The style is contorted linear in the species *L.annuus* and *L.cassius*.
10. The style is shortly dilated above in the rest of species. Concerning the style indumentums as in the table(7) the following groups are recognized :

1. Shortly hairy along the upper inner surface in the species *L.aphaca*, *L.hirsutus* and *L.rotundifolius*.
2. Pilose within in the species *L.ochrus*, *L.sativus*, *L.bijugus*, *L.odoratus*, *L.inconspicuus* and *L.vinealis*.
3. Hairy above on the inner surface in the species *L.nissolia*, *L.annuus*, *L.cassius* and *L.boissieri*.
4. Pilose along the upper inner surface in the rest of species.

Ovary

It is considered that the ovary in the studied species is orthotropous, superior, multiovules 3-12, monocarpels, monolcules and the placentation is marginal through ventral suture. Their indumentums is varied among the species under study, as in the table (7) to the following groups:

1. Silky tuberculate-based hairs and sessile glandulate in the species *L.hirsutus*.
2. Densely tuberculate-based hairs in the species *L.odoratus*.
3. Spreading tuberculate-based hairs in the species *L.chloranthus*.
4. Glabrous or shortly hairy in the species *L.nissolia*, and *L.pratensis*.
5. Glabrous or appressed hairy in the species *L.inconspicuus*.
6. Minutely glandular in the species *L.sativus*, *L.cicera*, *L.gorgoni*, *L.bijugus*, *L.annuus* and *L.cassius*.
7. Almost glabrous in the rest of species under study.

Fruit

The fruit is pod or legume arise from superior ovary, monocarpous. The study showed the variations in the shape, dimensions and colour of pods, as it is indicated in the table (8). The following groups of species were isolated according to the pod shapes:

1. The pod shape is rhomboid-oblong in the species *L.bijugus*.
2. The pod shape is linear straight narrowed at each end in the species *L.vinealis*.
3. The pod shape is linear straight abruptly narrowed at each end in the species *L.nissolia*.
4. The pod shape is linear oblong or broadly linear, compressed and narrowed at each end in the species *L.aphaca*, *L.annuus*, and *L.gorgoni* *L.hirsutus*.
5. The pod shape is linear, straight, compressed and narrowed at each end in the rest of the species.

The pod length of the studied species are classified into two major groups, the first has long pods exceed 50 mm in the species *L.nissolia*, *L.boissieri*, *L.annuus*, *L.chloranthus*, *L.rotundifolius*, *L.odoratus*, *L.ochrus* and *L.vinealis*, while the rest of studied species have pods 20-50 mm long.

The mature pod colour was also used in identifying the species under study, as it is brown in the species *L.aphaca*, black in *L.pratensis*, yellow or yellowish in *L.chloranthus*, *L.hirsutus*, *L.nissolia* and *L.odoratus*; yellowish-brown in *L.bijugus*, *L.annuus*; and yellowish reticulate-nerved in the rest of studied species, as the veins are close together in *L.inconspicuus* and finely distinct in *L.vinealis*.

Seed

Seed is a mature ovule that can develop into fruit after the processes of fertilization. Seeds differed in shape, length, colour and the format and decoration surface between type considered, as it is shown in the table (9). There are clear differences in the shape of the seeds, as it is rounded in the species *L.nissolia*; globose in the species *L.gorgoni*, *L.bijugus* and *L.sphaericus*; rounded to sub-quadrate in the species *L.vinealis*; compressed subquadrate in the species *L.sativus* and *L.cicera*; sub-globose in the species *L.ochrus* or sub-globose-ovoid in the species *L.pratensis*; compressed oval in the species *L.boissieri*; and spherical in the species *L.annuus*, *L.cassius* and *L.hirsutus*, and compressed rounded in the rest of taxa under study. The seeds of the species belonging to the genus *Lathyrus* have variation in their size, as the two biggest species in their seed size are *L.sativus* and *L.boissieri* with seed radial 6.7 mm; the smallest species in their seed size are *L.aphaca*, *L.nissolia*, *L.hirsutus*, *L.sphaericus*, *L.inconspicuus* and *L.pratensis* with seed radial 2.3 mm is of large-scale, where the rest of the species are intermediate between the two groups. The seed colour useful in distinguishing the studied species, as it is brown or speckled in the species *L.nissolia*, *L.bijugus* and *L.gorgoni*, grey to purplish-brown in the species *L.ochrus*, purplish-brown in the species *L.sphaericus*, brown mottled in the species *L.cicera*, *L.vinealis* and *L.pratensis*, blackish to purple in the species *L.odoratus*, chestnut brown in the species *L.rotundifolius*, dark brown in the species *L.hirsutus* or only brown in the rest of the species under study. The structure and decoration surface of the seed is another taxo-morphological tool for isolating the species of *Lathyrus* to the following groups:

1. The seed surface is verruculose in the species *L.nissolia*, *L.cassius* and *L.hirsutus*, densely verruculose in the species *L.annuus* or shallowly verruculose in the species *L.chloranthus*.
2. The seed surface is minutely pitted-rugulose in the species *L.odoratus*.
3. The seed surface is smooth and shining in the species *L.aphaca* and *L.pratensis*.
4. The seed surface is smooth in the rest of studied species.

DISCUSSION

A total of eighteen species of *Lathyrus* genus from 8 sections were studied. The Most of the significant traits for taxonomical purposes were from style and ovary which present important variations concerning their style shape and pod indumentum, as ten species groups of style and seven species groups of pod were found useful in isolation and classification of the species. Moreover, pod and seeds have obvious diversity in the shape, and also it has used in isolating four species groups of pods, nine species groups of seeds, and four species groups of each pod colour and seed surface. Floral leaves had also observable contribution in classification of the species of *Lathyrus* to different groups regarding flower traits, as each of the flower colour, peduncle length and inflorescence system had obvious taxonomical role in the field. While the root system was with little classification importance, the shoot system had respected role, especially the leaves traits regarding their shape, type of terminal leaflet(s) modification, and leaflets and stipules shape.

CONCLUSION

This study is the confirmation and addition to the morphological data regarding the endemic species of the genus *Lathyrus* for flora of Iraq. Although the morphological traits have the major role in pre-identifying and classifying the taxa, other data related to the paleontology, eco-geographic, anatomy, cytology and molecular study will be more confirming and completeness for the whole study of this genus in the region.



Lathyrus aphaca



L.nissolia



L.ochrus



L.sativus



L.cicera



L.gorgoni



L.bijugus



L.annuus



L.cassius



L.hirsutus



L.chloranthus



L.odoratus



L.rotundifolius



L.boissieri



L.sphaericus



L.inconspicuus



L.vinealis



L.pratensis

FIGURE 1. Flower colours of studied *Lathyrus* species

TABLE 1. Plant duration and stem characters of *Lathyrus* studied species

Taxa	Plant duration	Stem type	Stem length (cm)	Stem section	Stem indumentums
Sec.Aphaca <i>Lathyrus aphaca</i> L.	Annual	Scrambling /diffuse	≤ 50	Cylindrical	Glabrous
Sec.Nissolia L.nissolia L.	Annual	Erect	50-80	Angular	Glabrous
Sec.Clymenum <i>L.ochrus</i> (L.)DC.	Annual	Scrambling /diffuse	≤ 50	Angular winged	Glabrous
Sec.Cicercula <i>L.sativus</i> L.	Annual	Scrambling /diffuse	50-80	Angular winged	Glabrous
<i>L.cicera</i> L.	Annual	Scrambling /diffuse	≤ 50	Angular winged	Glabrous/ rarely pilose
<i>L.gorgoni</i> Parl.	Annual	Scrambling /diffuse	50-80	Angular winged	Glabrous
<i>L.bijigus</i> Bioss.	Annual	Erect	≤ 50	Angular winged	Glabrous
<i>L.annuus</i> L.	Annual	Scrambling /diffuse	> 100	Angular winged	Glabrous
<i>L.cassius</i> Bioss.	Annual	Scrambling /diffuse	50-80	Angular winged	Glabrous
<i>L.hirsutus</i> L.	Annual	Scrambling /diffuse	> 100	Angular winged	Glabrous
<i>L.chloranthus</i> Bioss.	Annual	Scrambling /diffuse	> 100	Angular winged	Dense soft spreading hairs
Sec.Lathyrus <i>L.odoratus</i> L.	Annual	Scrambling /diffuse	> 100	Angular winged	Long tuberculate-based hairs
<i>L.rotundifolius</i> Willd.	Perennial	Scrambling /diffuse	> 100	Angular winged	Glabrous
Sec,Platystylis <i>L.boissieri</i> Sirj.	Perennial	Erect	50-80	Angular	Glabrous
Sec.Orobastrum <i>L.sphaericus</i> Retz.	Annual	Erect/ decumbent	≤ 50	Cylindrical	Glabrous/ sparingly hairy
<i>L.inconspicuous</i> L.	Annual	Erect/ decumbent	≤ 50	Cylindrical	Glabrous/ rarely pilose
<i>L.vinealis</i> Bioss.	Annual	Erect/ decumbent	≤ 50	Angular	Glabrous/ rarely pilose
Sec.Pratensis <i>L.pratensis</i> L.	Perennial	Scrambling /diffuse	> 100	Winged angular	Semi-glabrous / appressed hairy

TABLE 2. Stipules and petiole characters of the leaf of *Lathyrus* studied species

Species	Stipules length (mm)	Stipules shape	Lobes or Segments shape	Petiole length (mm)	Petiole shape
<i>Lathyrus aphaca</i>	7.25	Fallacious ovate-hastate	Absent	Sessile	Non
<i>L.nissolia</i>	Minute	Filiform	Absent	Sessile	Non
<i>L.ochrus</i>	10.15	Semi-hastate	Absent	Sessile	Non
<i>L.sativus</i>	10.35	Semi-saggitate	Upper lobes lanceolate; lowers smaller, curved	15.30	Winged
<i>L.cicera</i>	10.25	Semi-hastate	Upper segments lanceolate ;lowers smaller curved	6.10	Winged
<i>L.gorgoni</i>	12.35	Semi-hastate	Upper segments lanceolate-oblong; lowers smaller falcate	10.20	Winged
<i>L.bijigus</i>	7.10	Semi-saggitate	Large upper segment linear-lanceolate	15.35	Distinctly winged
<i>L.annuus</i>	10.20	Semi-saggitate	The two subulate segments diverging at 150-180°	12.35	Distinctly winged
<i>L.cassius</i>	8.15	Semi-saggitate	The two subulate segments diverging at 150-180°	12.30	Winged
<i>L.hirsutus</i>	10.15	Semi-saggitate	Segments narrowly lanceolate-linear very widely diverging	10.20	Narrowly winged
<i>L.chloranthus</i>	7.10	Semi-saggitate	Narrow	15.35	Winged
<i>L.odoratus</i>	10.25	Semi-hastate	Upper segments lanceolate,lowers smaller	20-30	Winged

<i>L.rotundifolius</i>	8.25	Semi-hastate	curved Both lobes lanceolate	4.10	Winged
<i>L.boissieri</i>	10.14	Semi-saggitate	Lobes remotely dentate ,diverging 180°	Sessile	Non
<i>L.sphaericus</i>	4.17	Semi-saggitate	Segments lanceolate widely diverging – subulate	3.9	Normal
<i>L.inconspicuous</i>	5.11	Semi-saggitate	Segments entire widely diverging lanceolate subulate	3.5	Normal
<i>L.vinealis</i>	10.17	Semi-saggitate	Segments subulate,very narrow and acute	6.10	Normal
<i>L.pratensis</i>	11.37	Semi-hastate	Large lanceolate terminal lobe	12.35	Normal

TABLE 3. Leaf characters of *Lathyrus* studied species

Species	Leaf type	Leaflet shape	Terminal leaflet modification	Leaflet area (mm ²)
<i>Lathyrus aphaca</i>	Reduced to a simple tendril	Tendril	Simple very prehensile tendril	Tendril
<i>L.nissolia</i>	Reduced to narrow, grass-like phyllodes	Narrow grass-like phyllodes	Tendril is absent	900
<i>L.ochrus</i>	Lower leaves simple , uppers with 1.2 pairs leaflets	Broadly ovate-elliptic	Branched very prehensile tendril	810
<i>L.sativus</i>	Paripinnate with 1 pair of leaflets	Linear- lanceolate	Simple or branched very prehensile tendril	245
<i>L.cicera</i>	Paripinnate with 1 pair of leaflets	Linear- lanceolate	Simple or branched very prehensile tendril	180
<i>L.gorgoni</i>	Paripinnate with 1 pair of leaflets	Linear- lanceolate	Simple or branched very prehensile tendril	240
<i>L.bijigus</i>	Imparipinnate with 2 pairs of leaflets	Linear- lanceolate	Branched very prehensile tendril	550
<i>L.annuus</i>	Paripinnate with 1 pair of leaflets	Narrowly elliptic-linear	Branched very prehensile tendril	246
<i>L.cassius</i>	Paripinnate with 1 pair of leaflets	Narrowly elliptic-linear	Branched very prehensile tendril	240
<i>L.hirsutus</i>	Paripinnate with 1 pair of leaflets	Linear- oblong	Branched prehensile tendril	594
<i>L.chloranthus</i>	Paripinnate with 1 pair of leaflets	Ovate-oblong mucronate	Branched very prehensile tendril	675
<i>L.odoratus</i>	Paripinnate with 1 pair of leaflets	Ovate, elliptic oblong subulate	Branched tendril	995
<i>L.rotundifolius</i>	Paripinnate with 1 pair of leaflets	Ovate, elliptic or broadly obovate	Branched very prehensile tendril	1630
<i>L.boissieri</i>	Paripinnate with 1.2 pairs of leaflets	Lanceolate acute	4.8 mm arista	1720
<i>L.sphaericus</i>	Paripinnate with 1 pair of leaflets	Linear	Distinct cusp or simple tendril	200
<i>L.inconspicuous</i>	Paripinnate with 1 pair of leaflets	Linear-linear lanceolate	2.6 mm conspicuous cusp or simple branched very prehensile tendril	190
<i>L.vinealis</i>	Paripinnate with 1.2 pairs of leaflets	Linear	Long cusp or simple tendril	125
<i>L.pratensis</i>	Paripinnate with 1 pair of leaflets	Elliptic-lanceolate acute	Branched very prehensile tendril	145

TABLE 4. Calyx characters of *Lathyrus* studied species

Species	Calyx length (mm)	Teeth variation	Teeth shape	Teeth indument	Teeth/tube
<i>Lathyrus aphaca</i>	5.8	Sub-equal	Lanceolate	Conspicuously 3.5 nerved	3
<i>L.nissolia</i>	4.6	Unequal	Subulate	Glabrous	-
<i>L.ochrus</i>	6.9	Sub-equal	Lanceolate	Glabrous	≈
<i>L.sativus</i>	7.8	Unequal	Subulate	Glabrous or sparsely glandular	2-3
<i>L.cicera</i>	7.10	Sub-equal	Lanceolate-subulate	Glabrous or sparsely glandular	2.3

<i>L.gorgoni</i>	6.9	Sub-equal	Lanceolate	Glabrous or sparsely glandular	2
<i>L.bijigus</i>	5.8	Sub-equal	Lanceolate	Glabrous	Slightly longer
<i>L.annuus</i>	4.6	Equal	Triangular-lanceolate	Glabrous or 2.3 celled glands within	≈
<i>L.cassius</i>	4.6	Sub-equal	Broadly triangular-lanceolate	Furnished with sessile glands	=
<i>L.hirsutus</i>	6.8	Equal	Triangular-lanceolate	Glabrous or sparsely glandular	≈
<i>L.chloranthus</i>	7.10	Sub-equal	Lanceolate-acuminate	Densely hairy or somewhat glandular	2
<i>L.odoratus</i>	10.12	Sub-equal	Lanceolate	Fleuxose- hairy	2
<i>L.rotundifolius</i>	6.10	Unequal	Broadly triangular to triangular-lanceolate	Glabrous ,the teeth are ciliate	0.50-0.75
<i>L.boissieri</i>	5.7	Unequal	Triangular-lanceolate	Glabrous ,the teeth are ciliate	0.50-0.75
<i>L.sphaericus</i>	5.7	Equal	Subulate	Glabrous ,the teeth are ciliate	1.5
<i>L.inconspicuous</i>	3.5	Sub-equal	Subulate	Glabrous or thinly hairy	=/slightly longer
<i>L.vinealis</i>	6.9	Sub-equal	Subulate	Glabrous ,the teeth are ciliate	=/slightly longer
<i>L.pratensis</i>	5.8	Unequal	Lanceolate-subulate	Appressed hairy	0.50-0.75

TABLE 5. Flower characters of *Lathyrus* studied species

Species	Flowering system	Peduncle/ Petiole	Calyx /Corolla	Flower colour
<i>Lathyrus aphaca</i>	Solitary	Much exceeds	Slightly exceeding	Yellow or creamy
<i>L.nissolia</i>	Simple racemes of 1.2 (-3.4)	Much exceeds	2.0	Crimson
<i>L.ochrus</i>	Simple racemes of 1.2 (-3.4)	Much exceeds	2.0	White or creamy
<i>L.sativus</i>	Solitary flowers	Equal	2.0-2.5	Sky purplish-blue standard and wings , and keel is paler
<i>L.cicera</i>	Solitary flowers	Equal	1.5.2.0	Brick red to salmon pink or purplish
<i>L.gorgoni</i>	Solitary flowers	Longer about 2 - 6	2.0-2.5	Deep rose
<i>L.bijigus</i>	Solitary flowers	Longer about 2 - 6	2.0	Bluish
<i>L.annuus</i>	Simple racemes of 1.2 (-3.4) flowers	Longer about 2 - 6	2.5	Yellow to pinkish
<i>L.cassius</i>	Simple racemes of 1.2 (-3.4) flowers	Longer about 2 - 6	2.5	Pink
<i>L.hirsutus</i>	Simple racemes of 1.2 (-3.4) flowers	Longer about 2 - 6	2.0	Standard is crimson and wings are bluish
<i>L.chloranthus</i>	Solitary flowers, rarely 2 flowers	Longer about 2 - 6	3.0	Pale greenish yellow
<i>L.odoratus</i>	Simple racemes of 1.2(-3.4) flowers	Longer about 2 - 6	2.0-2.5	Various colours
<i>L.rotundifolius</i>	Simple dense racemes of 3.12 (-20) flowers	Longer about 2 - 6	2.5	Standard and wings are orange-red , and keel is yellowish
<i>L.boissieri</i>	Simple dense racemes of 3.12 (-20) flowers	Much exceeds	3.0	Lilac - magenta violet
<i>L.sphaericus</i>	Solitary flowers	Equal	1.5.2.0	Crimson
<i>L.inconspicuous</i>	Solitary flowers	Longer about 1/4	2.5	Standard pale blue - lilac other paler
<i>L.vinealis</i>	Solitary flowers	Longer about 2 - 6	1.5.2.0	Deep pink - crimson
<i>L.pratensis</i>	Simple dense racemes of 3.12 (-20) flowers	Longer about 2 - 6	2.5	Yellow , standard with a few darker streaks

TABLE 6. Corolla characters of *Lathyrus* studied species

Species	Standard Length (mm)	Standard shape	Wings length (mm)	Wings shape	Keel length (mm)	Keel shape
<i>Lathyrus aphaca</i>	8.12	Obovate-spathulate	7.11	Obovate	6.10	Oblong
<i>L.nissolia</i>	10.15	Obovate-spathulate	9.13	Obovate	8.12	Oblong apiculate
<i>L.ochrus</i>	12.17	Obovate-spathulate	10.15	Broadly obovate	9.14	Oblique deltoid-oblong
<i>L.sativus</i>	14.18	Obcordate	13.16	Broadly obovate	11.15	Oblique deltoid-oblong
<i>L.cicera</i>	9.13	Obcordate	8.11	Broadly obovate	7.10	Oblique deltoid-oblong
<i>L.gorgoni</i>	14.19	Obcordate	13.19	Narrowly oblong	12.17	Broadly deltoid-oblong
<i>L.bijigus</i>	8.12	Obcordate	6.9	Broadly obovate	5.8	Oblique obtuse
<i>L.annuus</i>	11.16	Broadly obovate	11.13	Obovate	10.12	Obliquely broadly deltoid
<i>L.cassius</i>	11.14	Broadly obovate	9.12	Obovate	8.11	Broadly deltoid
<i>L.hirsutus</i>	10.16	Obovate-spathulate	8.13	Oblong curved	7.11	Deltoid-subquadrate
<i>L.chloranthus</i>	13.18	Broadly obovate	11.14	Oblong	12.15	Oblong
<i>L.odoratus</i>	20-30	Obovate-spathulate	18.25	Very broadly ovate	15.20	Obliquely oblong
<i>L.rotundifolius</i>	15.21	Obovate-spathulate	13.17	Obovate	9.12	Sub-deltoid incurved
<i>L.boissieri</i>	13.16	Curved obovate-spathulate	11.15	Oblong-obovate	10.13	Falcate incurved
<i>L.sphaericus</i>	8.12	Obovate	8.11	Obovate	7.10	Deltoid-oblong
<i>L.inconspicuous</i>	7.11	Obovate-spathulate	5.10	Obovate	5.8	Oblique broadly oblong
<i>L.vinealis</i>	9.12	Obovate	8.11	Obovate	7.10	Oblong
<i>L.pratensis</i>	10.16	Broadly obovate-oval	8.13	Obovate-oblong	7.11	Falcate-oblong

TABLE 7. Gynoecium characters of *Lathyrus* studied species

Species	Style shape	Style indument	Ovary indumentums
<i>Lathyrus aphaca</i>	Straight dorsally compressed	Shortly hairy along the upper inner surface	Glabrous
<i>L.nissolia</i>	Straight dorsally compressed	Hairy above on the upper inner surface	Glabrous or shortly hairy
<i>L.ochrus</i>	Shortly dilated above	Pilose within	Glabrous
<i>L.sativus</i>	Contorted ventrally compressed	Pilose within	Minutely glandular
<i>L.cicera</i>	Shortly dilated above	Pilose along the upper inner surface	Minutely glandular
<i>L.gorgoni</i>	Spathulated at the apex	Pilose along the upper inner surface	Minutely glandular
<i>L.bijigus</i>	Shortly dilated above	Pilose within	Minutely glandular
<i>L.annuus</i>	Contorted linear	Hairy above on the upper inner surface	Minutely glandular
<i>L.cassius</i>	Contorted linear	Hairy above on the upper inner surface	Minutely glandular
<i>L.hirsutus</i>	Much compressed and spathulated	Shortly hairy along the upper inner surface	Silky tuberculate –based hairs and sessile glandulate
<i>L.chloranthus</i>	Contorted dorsally compressed	Pilose along the upper inner surface	Spreading tuberculate –based hairs
<i>L.odoratus</i>	Narrowly winged above	Pilose within	Densely tuberculate –based hairs
<i>L.rotundifolius</i>	Thick and contorted dorsally compressed	Shortly hairy along the upper inner surface	Glabrous
<i>L.boissieri</i>	Straight dorsally compressed	Hairy above on the upper inner surface	Glabrous
<i>L.sphaericus</i>	Shortly dilated and spathulated above	Pilose along the upper inner surface	Glabrous
<i>L.inconspicuous</i>	Much compressed and spathulated	Pilose within	Glabrous or appressed hairy

<i>L.vinealis</i>	Expanded straight near the apex	Pilose within	Glabrous
<i>L.pratensis</i>	Shortly dilated above	Pilose along the upper inner surface	Glabrous or shortly hairy

TABLE 8. Pod characters of *Lathyrus* studied species

Species	Pod shape	Pod dimension(mm)	Mature pod colour
<i>Lathyrus aphaca</i>	Linear oblong , compressed narrowed at each end	20-35 x 5.6	Brown
<i>L.nissolia</i>	Linear straight, abruptly below	30-60 x 2.3.5	Yellowish
<i>L.ochrus</i>	Oblong compressed, narrowed at each end	30-50 x 8.15	Yellowish reticulate veined
<i>L.sativus</i>	oblong , compressed narrowed at each end	25.30 x 10.15	Yellowish reticulate veined
<i>L.cicera</i>	oblong , compressed narrowed at each end	20-40 x 6.10	Yellowish reticulate veined
<i>L.gorgoni</i>	Linear oblong , compressed narrowed at each end	20-45 x 6.8	Yellowish reticulate veined
<i>L.bijigus</i>	Rhomboid-oblong narrowed at each end	12.18 x 5.9	Yellowish-brown reticulate veined
<i>L.annuus</i>	Linear oblong , straight compressed	35.60 x 7.9	Yellowish-brown reticulate veined
<i>L.cassius</i>	Linear straight, compressed	28.40 x 5.6	Yellowish-brown reticulate veined
<i>L.hirsutus</i>	Linear oblong , narrowed at each end	26.50 x 6.8	Yellowish
<i>L.chloranthus</i>	Linear straight, compressed narrowed at each end	40-56 x 6.9	Yellowish
<i>L.odoratus</i>	Linear straight, narrowed at each end	40-65 x 9.12	Yellowish
<i>L.rotundifolius</i>	Linear straight, compressed narrowed at each end	50-80 x 6.8	Yellowish reticulate veined
<i>L.boissieri</i>	Linear straight, compressed narrowed at each end	50-60 x 6.9	Yellowish reticulate veined
<i>L.sphaericus</i>	Linear straight, compressed narrowed at each end	25.50 x 4.5	Yellowish reticulate veined
<i>L.inconspicuus</i>	Linear compressed, narrowed at each end	25.50 x 3.5	Yellowish reticulate veined
<i>L.vinealis</i>	Linear oblong, narrowed at each end	40-55 x 5.7	Yellowish reticulate veined
<i>L.pratensis</i>	Linear straight, compressed narrowed at each end	20-40 x 4.6	Black

TABLE 9. Seed characters of *Lathyrus* studied species

Species	Seed Shape	Seed Radial (mm)	Seed Colour	Seed Surface
<i>Lathyrus aphaca</i>	Compressed rounded	2.3	Brown	Smooth and shining
<i>L.nissolia</i>	Rounded	2.3	Brown or speckled	Verruculose
<i>L.ochrus</i>	Sub-globose	4.6	Grey to purplish-brown	Smooth
<i>L.sativus</i>	Compressed sub-quadrate	6.7	Brown	Smooth
<i>L.cicera</i>	Compressed sub-quadrate	4.6	Brown or mottled	Smooth
<i>L.gorgoni</i>	Globose	3.5	Brown or speckled	Smooth
<i>L.bijigus</i>	Globose	3.5	Brown or speckled	Smooth
<i>L.annuus</i>	Spherical	4.5	Brown	Densely verruculose
<i>L.cassius</i>	Spherical	3.4	Brown	Verruculose
<i>L.hirsutus</i>	Spherical	2.3	Dark brown	Verruculose
<i>L.chloranthus</i>	Compressed rounded	4.5	Brown	Shallowly verruculose
<i>L.odoratus</i>	Spherical sub-quadrate	4.5	Blackish-purple	Minutely pitted-rugulose
<i>L.rotundifolius</i>	Compressed rounded	4.5	Chestnut brown	Smooth
<i>L.boissieri</i>	Compressed oval	6.7	Brown	Smooth
<i>L.sphaericus</i>	Globose	2.3	Purplish-brown	Smooth
<i>L.inconspicuus</i>	Compressed rounded	2.3	Brown	Smooth
<i>L.vinealis</i>	Rounded to sub-quadrate	3.4	Brown or mottled	Smooth
<i>L.pratensis</i>	Sub-globose to ovoid	2.3	Brown or mottled	Smooth and shining

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