

**An unusual occurrence of a toothed keel in
Lotus arborescens Lowe ex Cout. (Leguminosae, Loteae)**

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Summary: An individual of *Lotus arborescens* (Leguminosae, Loteae) possessing a toothed keel in most flowers has been discovered. Such a keel structure has not previously been reported in any species of the tribe Loteae. Although, superficially a similar keel structure is typical for some species of *Oxytropis* (tribe Astragaleae). Our examination shows that the keel teeth of *Oxytropis* and *Lotus arborescens* are not homologous to each other.

Keywords: *Lotus*, Fabaceae, keel, flower morphology

During the years 2002 to 2004, the first author guided several field trips to the Macaronesian islands (the Azores, Madeira, Canary Islands, and Cape Verde Islands) with the aim to conserve and study species of *Lotus*, section *Pedrosia*. Most species of the section (often regarded as a subgenus) are endemic to the Macaronesian islands (MONOD 1980; BROCHMANN et al. 1997) and often occur in relatively isolated areas. The field trips resulted in a seed collection that covers a vast majority of the Macaronesian species of the genus *Lotus*, section *Pedrosia*. Most species are represented by several accessions (populations) in the collection. Seeds of the collection are stored at the *Medicago* Genetic Resource Centre in South Australia, for long term conservation. A living collection, originating from the collected seeds, has also been established at the University of Western Australia, Perth. The living collection was founded in 2004 to facilitate the comparison of morphological traits and eliminate environmental effects as a factor influencing plant form, growth and development. Sixteen plants from each accession were planted in a nearest-neighbour design with two replicates (CULLIS 1991). This provides a unique opportunity to study infraspecific, morphological variability in members of the section *Pedrosia*.

Studies of morphology were conducted in early 2005 and identified a plant of *Lotus arborescens* Lowe ex Cout., possessing toothed keels in most flowers. The plant was grown from seeds collected on São Nicolau, Cape Verde (lat. 16°36.561', long. 24°19.287', alt. 623m, accession nr. SA40354). Only one of the sixteen plants grown from seeds of this accession shows a toothed keel. The tooth is a hollow outgrowth situated on the lower side of the keel, below the keel tip. Both keel petals contribute equally to the tooth. Their margins are fused to each other throughout the whole tooth length (fig. 1g). The tooth, however, varies in size between flowers of the sample plant. If the tooth is small, it lies almost in the same median plane like the keel (fig. 1b,f). If the tooth is large, its base is curved to one side and becomes appressed to one of the keel petals (fig. 1a,c,e). In the latter case, flowers are rather asymmetric than monosymmetric.

The plant showing the toothed keels is otherwise typical for *Lotus arborescens*. The flowers produce abundant pollen (fig. 1d) and normal fruits and seeds. Seeds from the discussed plant have been collected to determine if the described morphological abnormality is genetically

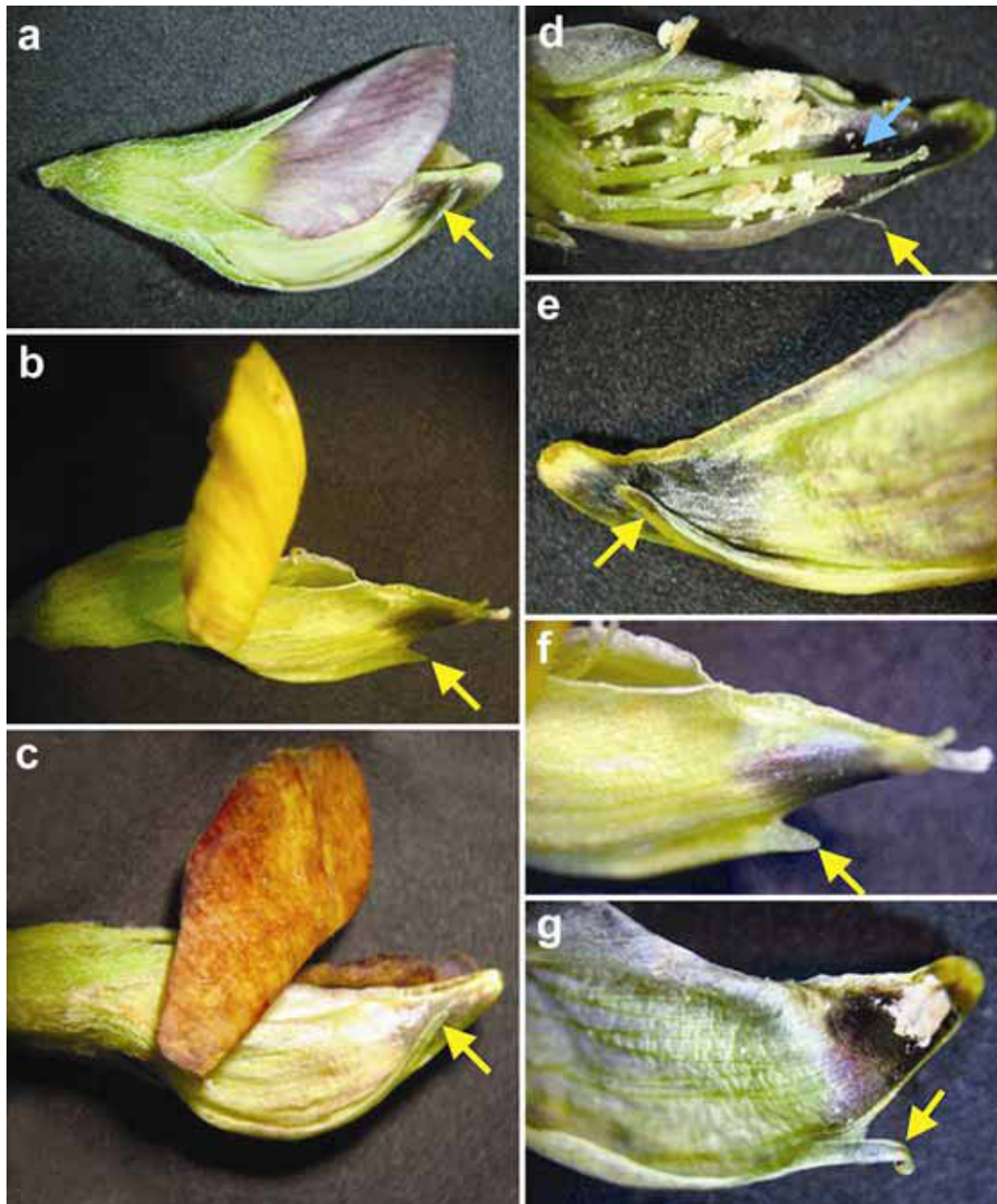


Figure 1: Unusual keel structure in *Lotus arborescens* Cout.: a, c) flowers with one wing petal removed to show the keel; b) flower with both wings removed; d) keel dissected to show stamens and style; e, g) fragment of dissected keel; f) keel fragment. Yellow arrows, keel tooth; light blue arrow, style tooth.

determined. The authors estimate this character to be the result of an unknown mutation as other plants of the same accession and other accessions of this species, grown under the same conditions, have no traces of a keel tooth.

Lotus arborescens is one of five species of the section *Pedrosia* which are endemic to Cape Verde Islands (BROCHMANN et al. 1997). These species are of particular interest because they are

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located at a significant distance from the nearest diversification centres of *Lotus* (Canary Is. and Morocco). *Lotus arborescens* has also a very local distribution area being restricted to the western mountain range of the island São Nicolau (BROCHMANN et al. 1997). Nevertheless, this species, like other Cape Verde *Lotus* species, demonstrates a very high level of morphological diversity in natural populations. For example, Cape Verde species vary considerably in petal colour (yellow through to black/purple mix), degree and type of hairs on stems and leaves (straight or curved, patent or appressed), and leaf morphology. Our finding of a toothed keel in *Lotus arborescens* shows, that Cape Verde species of *Lotus* are useful for the search of new morphotypes which could provide insights into the progression of speciation. Furthermore, the conservation of Cape Verde *Lotus* is a very important task as natural populations have tended to become smaller in recent times.

A toothed keel has not previously been recorded for members of the tribe Loteae. Among other legumes, a toothed keel is typical for the genus *Oxytropis* DC. In many species of *Oxytropis*, the tooth is situated at the tip of the keel, while in others it appears to be attached to the keel lower side (like fig. 1d). This is superficially similar to the toothed keel in *Lotus arborescens*. However, from the morphological point of view, the keel tooth of *Oxytropis* is always a terminal structure of the keel. In *Oxytropis* keel petals are fused only along the proximal side of the tooth. They are free from each other along the distal side of the tooth as well as distally at the tooth attachment place. The end of the fusion line clearly indicates the morphological tip of the keel in *Lotus* and *Oxytropis*. In *Lotus arborescens* the morphological tip is situated well above the place of tooth attachment. Thus the teeth of *Lotus arborescens* and *Oxytropis* are not homologous to each other. Furthermore, the genus *Oxytropis* belongs to the tribe Astragaleae and has no close relationship to *Lotus*.

Asymmetric flowers are known in several legume groups (see ENDRESS 1999; PRENNER 2004), including the tribe Loteae. However, in the tribe Loteae, an asymmetric corolla is typical for the genus *Ottleya* (SOKOLOFF 1999) but it has not been recorded for *Lotus* until now.

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