

# Ex-situ Conservation of *Thermopsis turcica* Kit Tan, Vural & Küçüködük in Nezahat Gökyiğit Botanic Garden, Turkey

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## Introduction

Fabaceae belongs to one of the largest families of dicotyledons. It is a large, diverse family ranging from herbaceous annuals to woody perennials that, because of their capacity to fix nitrogen, are essential components in natural and managed terrestrial ecosystems. *Thermopsis turcica* Kit Tan, Vural & Küçüködük is the sole endemic representative of the genus *Thermopsis* R. Br. in Turkey. The occurrence of 2-3 free carpellate-ovary is the main morphological character of this rare plant, first recorded in the *Papilionoideae* subfamily of Fabaceae.

*Thermopsis turcica* (Pیان) is an endemic perennial herb with large rhizome in the East Mediterranean region. *Thermopsis* is a genus confined to the Central Asia and the East United States, and it is represented by only one endemic species, *T. turcica* in Turkey. The unique character of *T. turcica* is the uniform occurrence of three free carpels. The polycarpellary condition of *T. turcica* is a clearly derived, rather than a primitive character since the whole Papilionoid pollination syndrome has obviously evolved around the presence of a single median carpel (Davis et al. 1988, Kit et al. 1983). Although presence of polycarpellary condition has been previously documented in normal members of the Mimosoideae and Caesalpinoideae, apart from teratological forms, this is the first record in the Faboideae (Kit et al. 1983).

It spreads on the south shores of Eber Lake, and the south and south-west shores of Akşehir Lake, in west-central Anatolia. Destruction of marshy habitats by excessive drainage of lake water, causing consequent water withdrawals from Eber and Akşehir Lakes, and the utilization by the locals of the best habitats containing native vegetation are the major threats for the region. Therefore, almost all populations of *T. turcica* are in agricultural lands and under heavy destruction. In addition, it is not possible to obtain viable and germinable seeds from the plants growing in farmlands because unidentified seed predators (probably Coleoptera) utilize *T. turcica* seeds for larval development. Therefore, the major regeneration mode of this endangered species is through rhizomes.

The literature searching of *Thermopsis* revealed that there has been no anatomical study. Investigations have been performed on the chemical constituents of *Thermopsis* species (Asilbekova 2004, Kotenko et al. 2001). Apart from the morphological description of *T. turcica* (Kit et al. 1983), there has been only one study on the alkaloids of the species (Rahman et al. 1991). It is reported that some *Thermopsis* species contain alkaloids, flavanoids, vitamin C, macro and microelements. The air-dried aerial part is used as a medicinal raw material for a cytosine preparation and as an expectorant (Asilbekova 2004, Kotenko et al. 2001). On the other hand, the genus *Thermopsis* consists of poisonous and harmful species with low feeding value (Li 1997, Zhang and Lui 1996). *Thermopsis* species have been suspected of causing livestock losses. In addition, series of human poisoning by *Thermopsis* has been reported. Twenty three suspected cases of *Thermopsis* exposures, some resulting in significant toxicity like vomiting, abdominal pain, drowsiness, oral irritation, tachycardia, tremors and other general symptoms are reported (Mcgrath-Hill and Vicas 1997). Some *Thermopsis* are also used as ornamentals in the United States (Lockhart 2005). Since there is no report ex-situ conservation on the anatomical features of *Thermopsis*, morphological characters of a Turkish endemic, *T. turcica* have been reported here in detail.

## Material and Methods

In this study, morphological properties of **critically endangered (CR)** *Thermopsis turcica* Kit Tan, Vural & Küçüködük distributed around Akşehir Lake (38° 30' N and 31° 18' E) and Eber Lake (38° 36' N and 31° 14' E) are investigated. The goal is to determine the taxonomic status of *T. turcica* by examining morphological properties and to help prospective plants conservation and plant breeding studies.

There have been a number of morphological, anatomical and phylogenetic studies of the subfamily Faboideae (Aniszewski et al. 2006, Wang et al. 2006, Yiotis et al. 2006, Oliveira and Paiva 2005, Ainouche et al. 2003, Doyle et al. 2000, Ainouche and Bayar 1999, Pereira-Netto et al. 1999, Talavera and Gibbs 1997 and Crow et al. 1997). Pیان included in plants protection projects of Nezahat Gökyiğit Botanic Garden collections in 2009. For this purpose, we created ex-situ conservation area named "**Pیان Conservation Area**" in the central island of our garden. As part of the conservation project, which is intensifying since 2010, morphological characterization was researched in the Pیان Conservation Area.



Fruits of *Thermopsis turcica* (CR).



Ex-situ Conservation Area of *Thermopsis turcica* in NGBB.

## Results and Discussions

In morphological studies, metric measurements were taken on root, stem, leaf, flower, fruit, petiole and seed of 20 specimens. The outcomes are compared with the morphological characterization research, which is done for the individual species in the area (Table 1).

### Morphological features

*T. turcica* is a perennial herb with long rhizome. Erect stem up to 25-55 cm in length and densely white-villous in the upper parts. Leaves alternate, digitately trifoliolate, white sericeous or sometimes white-villous, becoming greyish-green. Stipules leaf-like, free, those on the main stem much larger than those at the leaf bases, acute. Petioles 0.5 – 2.2 cm in length. Leaflets elliptic-ovate, 11 - 31 × 4 - 14 mm in dimension, acute, densely white-villous on both surfaces. Inflorescence terminal, racemose, 10 - 22 cm. Flowers large, bracteate, zygomorphic, hermaphrodite. Bracts leaf-like, ovate, 5 - 11 × 3 - 9 mm, white-villous, the margins long ciliate. Pedicels up to 21 mm. Calyx 9 - 13 mm in length, densely white-villous, unequally 5-toothed, bilabiate, the upper lip forming 2 teeth of ca. 6 – 8 mm, the obtuse lobe sometimes cleft to 1.4 mm; the lower lip forming 3 teeth, nearly equal, triangular-acute, 4.5 - 5.5 × 2.5 - 3.0 mm in dimension. Petals golden yellow in colour, imbricate, free except for partly connivent keels. Standard glabrous. Stamens 10 and free. Filaments filiform, not dilated, 18-20 mm in length, glabrous; anthers uniform, dorsifixed, 1.8 mm in length, yellow in colour. Disc absent. Ovary 3-carpellate, carpels free, each 1-locular, nonseptate, white-villous, sessile; ovules 10 in number and on the adaxial suture; style ca. 12-13 mm, glabrous, recurved at apex, persistent in fruit; stigma terminal, small and capitate. Fruit a legume, 2-3 seeded, elliptic- or oblong-ovoid, 22-25 × 7-9 mm in dimension, slightly falcate, nearly straight at maturity, densely sericeous-villous, indehiscent. Seeds exarillate, subreniform in shape, 2 - 5 × 2 - 3 mm, smooth, not foveolate, pale purplish.

The Rocky Mountains and intermountain regions are populated by the relatively variable and some widespread *Thermopsis* species in North America (Chen et al. 1994) while the habitat of endemic *T. turcica* is marshy lakeside of about 950 - 1050 m in altitude in Turkey. The authors aimed to introduce endemic *T. turcica*, the first record of the genus *Thermopsis* for Turkey. *T. turcica* can be used as an ornamental plant, for their large, attractive and golden yellow flowers.

Further studies are needed for cultural needs, physiology, breeding biology, hybridization studies and possible conservation measures of this important endemic Turkish plant species which has medicinal values.

### *Thermopsis turcica* Conservation Project Process in NGBB

\* "Pیانlık" (Pیان Conservation Area) was built as an ex-situ protection area for Pیان (*Thermopsis turcica*) plant, and rhizoms of plants brought from the field was planted here. New seeds were planted in collaboration with Propagation Department for morphological calibration studies, and taken under observation. The pیان seedlings that were already in hand were planted into the observation area in 2009.

\* The pیان was planted to the in-situ area in 2010. Preparations for hybridization studies are underway.

\* Morphological characterization studies on Pیان plant were researched in 2011. Hybridization studies were also done but turned inconclusive. Artificial hybridization studies have been started for this reason.

\* Characterization studies that had been underway for 3 years were completed in 2012. It was found out that new individual breeding possibility was fallen greatly after three years and new individual reinforcements are required to renew the population in ex-situ protection efforts. This reinforcement was done through new individuals acquired from field excursions.

\* Several research and studies about flower physiology and morphology, breeding biology were done. Sabanci Universities conducted tissue culture and hybridization studies in 2013.

Characters	Individual Species Area Study (Özdemir & et. al, 2008)	Ex-situ Pیان Conservation Area. (Çingay, 2012)
Flowering Time	March - May	March - June
Stem	35 – 80 cm.	25 – 55 cm.
Leaflets	11 - 40 × 4 - 16 mm.	11 - 31 × 4 - 14 mm.
Inflorescence	10 - 22 cm.	12 - 35 cm.
Bracts leaf	5 - 11 × 3 - 9 mm.	7 - 15 × 3 - 11 mm.
Calyx	9 - 13 mm.	9 - 13 mm.
Teeth	4.5 - 5.5 — 2.5 - 3.0 mm.	4.5 - 5.5 × 2.5 - 3.0 mm.
Fruit	22-25 × 7-9 mm.	22-25 × 7-9 mm.
Seeds	3.5-5 × 2.5-3 mm.	2 - 5 × 2 - 3 mm.

Table - 1 Morphological characterization research of *Thermopsis turcica*.

### Results and Discussions

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