

A REVIEW OF THE GENUS *ALNUS* GAERTN. IN IRAN, NEW RECORDS AND NEW SPECIES

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The genus *Alnus* Gaertn., with approximately 20 species, is of great economic importance and some of the species are as the source of timber in the north hemisphere. In the Hyrcanian forests, the trees of this genus have many critical roles especially in forest rehabilitation. Like most of woody plants in Hyrcanian forests, there are many taxonomic problems concerning the recognition of the species of the genus *Alnus* in Iran. To cope with, during the long term study on the trees of this genus in the most parts of Hyrcanian forests, many specimens of these trees in the field and in different sites were collected. The studies were performed on living and herbarium specimens and some of the most important local herbarium materials were studied too. According to the previous studies, the genus *Alnus* in Iran includes two species: *Alnus glutinosa* Gaertn. subsp. *barbata* (C. A. Mey) Yaltrik and *Alnus subcordata* (C. A. Mey.) Yaltrik with two varieties which are distributed in Hyrcanian forests. The results obtained from many specimens of *Alnus* revealed that there are three extra species and records including: *Alnus djavanshirii* Zare, *Alnus dolichocarpa* Zare, Amini & Assadi and *Alnus orientalis* Decne. as well as two subspecies viz. *Alnus glutinosa* Gaertn. subsp. *glutinosa* and *Alnus glutinosa* Gaertn. subsp. *antitaurica* Yaltrik. In this paper, botanical characteristics and ecology of the taxa are elaborated.

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Keywords. *Alnus*, Hyrcanian forest, new species, taxonomy, Mazandaran, Iran.

مروری بر جنس توسکا در ایران، گزارش‌ها و گونه‌های جدید

حبیب زارع، استادیار پژوهشی مرکز تحقیقات کشاورزی و منابع طبیعی مازندران، هرباریوم باغ گیاه‌شناسی نوشهر.

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جنس توسکا با تعداد حدود ۲۰ گونه، یکی از منابع مهم تولید چوب در نیمکره شمالی است. در جنگل‌های هیرکانی علاوه بر اهمیت اقتصادی فراوان آن، نقش اکولوژیکی منحصر به فردی در بازسازی طبیعی جنگل‌های تخریب یافته دارد. همانند بسیاری از گونه‌های درختی و درختچه‌ای، مشکلات تاکسونومیک نسبتاً زیادی پیرامون شناسایی گونه‌های این جنس وجود دارد. در این رابطه برای برطرف سازی مسایل موجود، در طی این تحقیق، تعداد بسیار زیادی از نمونه‌های زنده در کنار بررسی نمونه‌های هرباریومی از رویشگاه‌های مختلف تهیه و مطالعه شد. نتایج مطالعات نشان داد، علاوه بر حضور ۲ گونه توسکا در جنگل‌های شمال شامل: *Alnus glutinosa* Gaertn. subsp. *barbata* (C. A. Mey) Yaltrik و *Alnus subcordata* (C. A. Mey.) Yaltrik به همراه ۲ واریته معروف آن، تعداد ۲ گونه جدید به نام *A. djavanshirii* Zare, Amini & Assadi و *A. dolichocarpa* Zare, Amini & Assadi و یک گونه رکورد به نام *A. orientalis* Decne. به همراه ۲ زیر گونه دیگر از توسکا قشلاقی شامل *A. glutinosa* Gaertn. subsp. *glutinosa* و *A. glutinosa* Gaertn. subsp. *antitaurica* Yaltrik به جنس توسکا در ایران اضافه شده است.

INTRODUCTION

There are ca. 20 species of the genus *Alnus* in the world (Kuzeneva 1936). This genus is a source of timber and

consequently is of great economic importance. It has a vital role in forest formations especially in Hyrcanian forests. Moreover, the species grow rapidly and easily

on degradation soils of forest ecosystems. They are dependent on moisture availability of the forest sites and can be observed in the riverbank, swamp, and often near springs (Zare & Habashi, 2000). The genus *Alnus* in Iran includes two species viz. *Alnus glutinosa* Gaertn. subsp. *barbata* and *Alnus subcordata* (C. A. Mey.) Yaltrik including var. *subcordata* and var. *villosa* (Regel) H. Winkl. which are distributed in Hyrcanian forest of northern Iran (Sabeti 1976). Some botanists have previously studied the genus *Alnus* in Iran, e.g. Browicz (1972) in Flora Iranica. There are a lot of sites in Hyrcanian forests zone that have not been studied yet. Evidence of this claim are the reports of many new species and records recently added to the flora of Iran by botanists. A comprehensive and continuous study on genus *Alnus* in Iran, over the course of seven years, helped the authors to find new taxa.

The aim of this study was to prepare the draft of Flora of Iran by the first author (Assadi 1989). In this paper it presents a review of the genus in Iran, to report new taxa to Iran, to describe new taxa for Iran and to elaborate botanical characteristics and ecology of the mentioned taxa.

MATERIALS AND METHODS

The study area covers Golestan, Mazandaran and Gilan provinces in the North of Iran, from East to West and also in altitudinal range close to the beach to the upper parts of northern slopes of Alburz Mountains (1800 m.a.s.l.) with approximate geographic coordinates: 35°49 to 38°40 N, 48°55 to 56°57 E in the forest zone of Hyrcanian province of the Europe-Siberian region. Corresponding field data included taxonomical details of the specimens and environmental variables (habit, phenology, abundance, habitat, latitude, altitude, soil type and plant associations). This also accounted for local morphological variation within the different sites of each ecosystem. Moreover, sampling exploration was made in the study area and included nearly every month of the growth period. All studies were performed on living and herbarium specimens. On the basis of the altitudinal range, species were separated and established in two groups of lower and upper parts. A number of morphological observations were applied to determine the variation of organs. For example, leaf shape, teeth type at the margin, form of leaf tip and base, type and form of hairs on the organs, fruit shape and scales, seed and the wings were studied. In addition, specimens of the largest Iranian herbaria including TARI, TUM and local ones i.e. Nowshahr, Golestan and Gilan provinces and the herbarium of Swedish Museum of Natural History were studied. The aim of this paper is to present a taxonomic review of

the genus *Alnus* in Iran including some ecological preferences of the taxa concerned.

RESULTS AND DISCUSSION

Five species of the genus *Alnus* with different botanical and ecological sites are recognized from Iran. Prior to this research (Browicz, 1972); two species of *Alnus* named *Alnus glutinosa* subsp. *barbata* and *Alnus subcordata* with two varieties: var *subcordata* and var *villosa* were known from Iran.

Supplementary studies on specimens and trees in the sites showed that there are more species including *Alnus orientalis* mixed with *Alnus subcordata* in the river banks of Gatekash with Mediterranean or sub-Mediterranean climatic condition in south of Nowshahr, Mazandaran province. Natural distribution range of this species is East of Mediterranean Sea in North West Syria and also Southern Turkey. Mediterranean conditions in subsidiary valleys in northern slopes of Alborz Mountains has caused distribution of Mediterranean elements. Kojour valley is one of the specific climate zone and harbor for *Alnus orientalis* where *Cupressus sempervirens* L. var. *horizontalis* (Mill.) Aiton, is dispersed as a well-known Mediterranean element. In addition, two subspecies of *Alnus glutinosa* including subsp. *glutinosa* and subsp. *antitaurica* are added to this taxon. Based on the study of some specimens and the comparison between them and Floras in the Euro-Siberian region viz. Flora Europaea (Tutin et al, 1964), Flora of Turkey (Yaltrik, 1982) and Flora of the U.S.S.R (Kuzeneva, 1936) two new species viz. *Alnus dolichocarpa* in the river banks near Caspian Sea beach and *Alnus djavanshirii* on the mid-altitude zone of Hyrcanian forests were recognized. In this paper the new records to Iran are reported and the new species are described. New identification key of the genus *Alnus* in Iran and its ecological and botanical characteristics are explained here.

New records to Iran

A. orientalis Decne., Ann. Sci. Nat. ser. 2, 4: 348 (1835). Fig. 1, Map 1.

Alnus orientalis is related to *Alnus subcordata* and both are very similar in overall appearance. *A. orientalis*, due to having dense and relatively twisted leaves and the pressed and compact crown is distinguishable from the other species at a distance. *A. orientalis* is different from *Alnus subcordata* by having the leaves double-serrate at the margin, roundish, not subcordate at the base, with the stomata located on the upper side and ± glabrescent on the lower side. This species is distributed in Kojour valley close to *Cupressus*

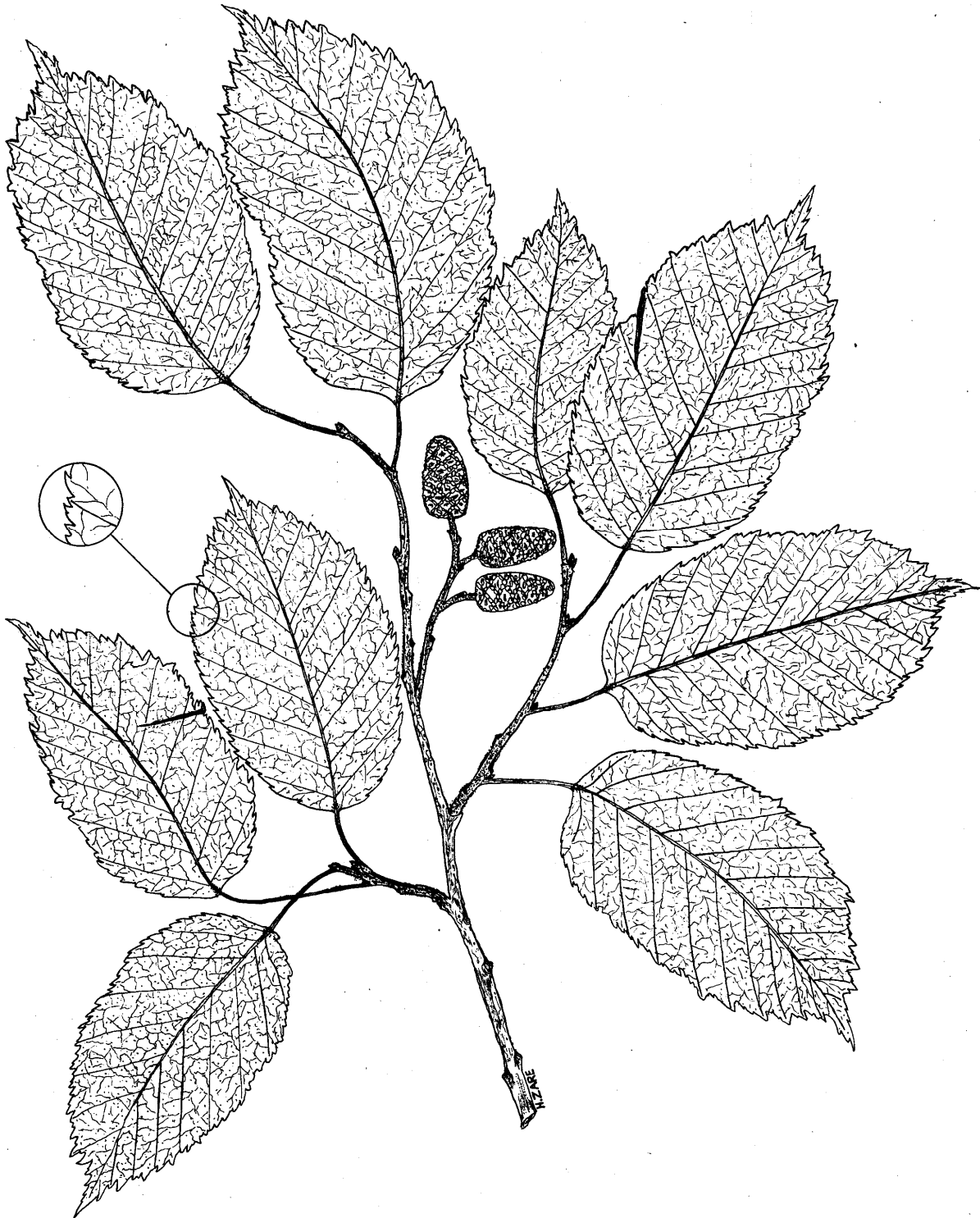


Fig. 1 *Alnus orientalis* ($\times 0.87$).

sempervirens L. var. *horizontalis* sites where climate is different from the other Hyrcanian forest sites and dominant with Mediterranean climatic condition. According to the natural distribution area of *Alnus orientalis* i.e. east of Mediterranean, it can be introduced as a Mediterranean tree element for the submediterranean ecosystems in Hyrcanian forests.

Tree, 20-25 m. high and 80-100 cm. in diameter; crown upright or spreading. Bark of young trees smooth and light gray, in old trees with shallow tracks and dark gray. Young twigs light green and becoming brownish, glabrous or with scattered brown or grayish hairs. Twigs cross-section rounded or relatively angular, along with many orange lens and glands. Winter buds shortly stalked or sometimes sessile, ovate, along with leaves is sticky at burst time. Leaves elliptic, ovate or sometimes long ovate, in the young stage and on fertile branches relatively inequilaterally or from central nerve to margin is raised and undulate, 6-11 cm. long and 4.5 cm. broad, acuminate or abruptly long-acuminate and rarely obtuse at apex, rounded and sometimes cuneate or rarely cordate at base, double serrate at the margin with the teeth near the apex larger, relatively glossy dark green and glabrous on the upper surface, in lower surface pale green and glabrescent except for scattered hairs on the vein specially in axillary veins; veins 8-10 pairs and straight, usually with dark glands throughout; petioles 2-3 cm long, glabrous or sparsely pubescent, yellowish green. Male catkins thick and relatively short 4-6.5 cm long and 0.8 – 1.2 cm broad, usually 2 or 4 together on last year twigs; female catkins green and more or less sticky. Fruits long ovate, 1.8 – 2.5 cm. long and 1.5 – 2 cm. broad, shortly 8-10 mm long stalked or sometimes sessile, without distinct bracts on the scales. Seeds light brown, without wing or with indeterminate and leathery wings, often glandulous. Fruits are matured at the end of October.

Specimens examined. Mazandaran: Nowshahr, Kojour region, margin of river bank near Gatekash, 900 m. Zare and Amini 10599 (HNBG), same region, between road to Veisar and Gatekash, 800m., Zare and Amini, 10598 (HNBG).

Geographical distribution. Sicily Italy, Cyprus, Turkey, Syria, Lebanon.

***Alnus glutinosa* (L.) Gaertn.**

Alnus glutinosa (L.) Gaertn. is one the most important species distributed in Caspian lowland forests especially in the swamps and riverbanks. The formerly known subspecies from Iran is subsp. *barbata* (Browicz, 1963) (Fig. 2). Form and margin of the leaves show great differences, variably mucronate, rounded, acute and or lobed at 1/3 apex between

populations, especially on juvenile leaves. In spite of these, the leaves on fertile branches at the end of crown are very small, often leathery, lanceolate or spathulate with large teeth or lobes. In addition, shape of the strobils and seeds are remarkable. According to the mentioned characteristics, other subspecies in Iran are recognized.

subsp. *glutinosa*

Specimens examined. Mazandaran: Nowshahr, Mashlak riverbank, -12 m, Zare and Amini, 10616; Nowshahr, Botanical Garden, -20 m, Zare and Amini, 10617; Nowshahr, Chalandar, Sabeti, 1261; Nowshahr, road to Maadan, 60 m, Zare and Amini, 10684, Nowshahr, margin of Mazga river, -10 m, Zare, 10649.

Geographical distribution. north western Africa, Europe except for the northern and southern border areas, Turkey, Caucasus and Iran.

subsp. *antitaurica* Yalt., Notes R. B. G. Edinb. 28: 15 (1967). Fig. 3, Map 2.

Specimens examined. Mazandaran: Amol, Haraz road, 30 m, Kukkonen, 5581; Nowshahr, Shokrikola, margin of irrigated farming, -10 m, Zare and Amini, 10626. - Gilan, Fuman, 8 km to Masouleh, Abroud village, 400 m, Zare and Amini, 10625.

Geographical distribution. East of Turkey, North of Iran.

***Alnus dolichocarpa* Zare, Amini & Assadi, sp. nov.** Fig. 4, Map 3.

Affinis *A. glutinosa* sed dentibus foliorum majoribus, foliis acuminatis vel caudatis, cordatis, fructibus usque ad 4 cm longis, seminibus asymmetricis.

A. dolichocarpa is closely related to *A. glutinosa*. There are some remarkable botanical characteristics in *A. dolichocarpa* including leaves with large triangular teeth in 1/2 to 1/3 upper half of leaf margin, leaf apex long-acuminate or caudate, often cordate at base, largest fruit compared with others up to 4 cm long, prominent ligule on the surface of cone scales and often asymmetrical seed. Whereas in *A. glutinosa* leaves have irregular and small teeth at the margin, acute at the apex, usually cuneate or rarely rounded at the base, fruits small, up to 1.8 cm long, ligules on the surface of scales very small and seeds usually symmetric.

Trees up to 20 (25) m. high and 0.8 m stem diameter; bark of tree grooved and with formless and cut scales, dark gray; young twigs angled and distinctly triangular, grayish with sparse gray or light brown hairs including gray glands. Winter buds with short stalk, dark brown to black, pubescent; leaves inside the buds crouching in the middle, reddish and covered with sticky glands.

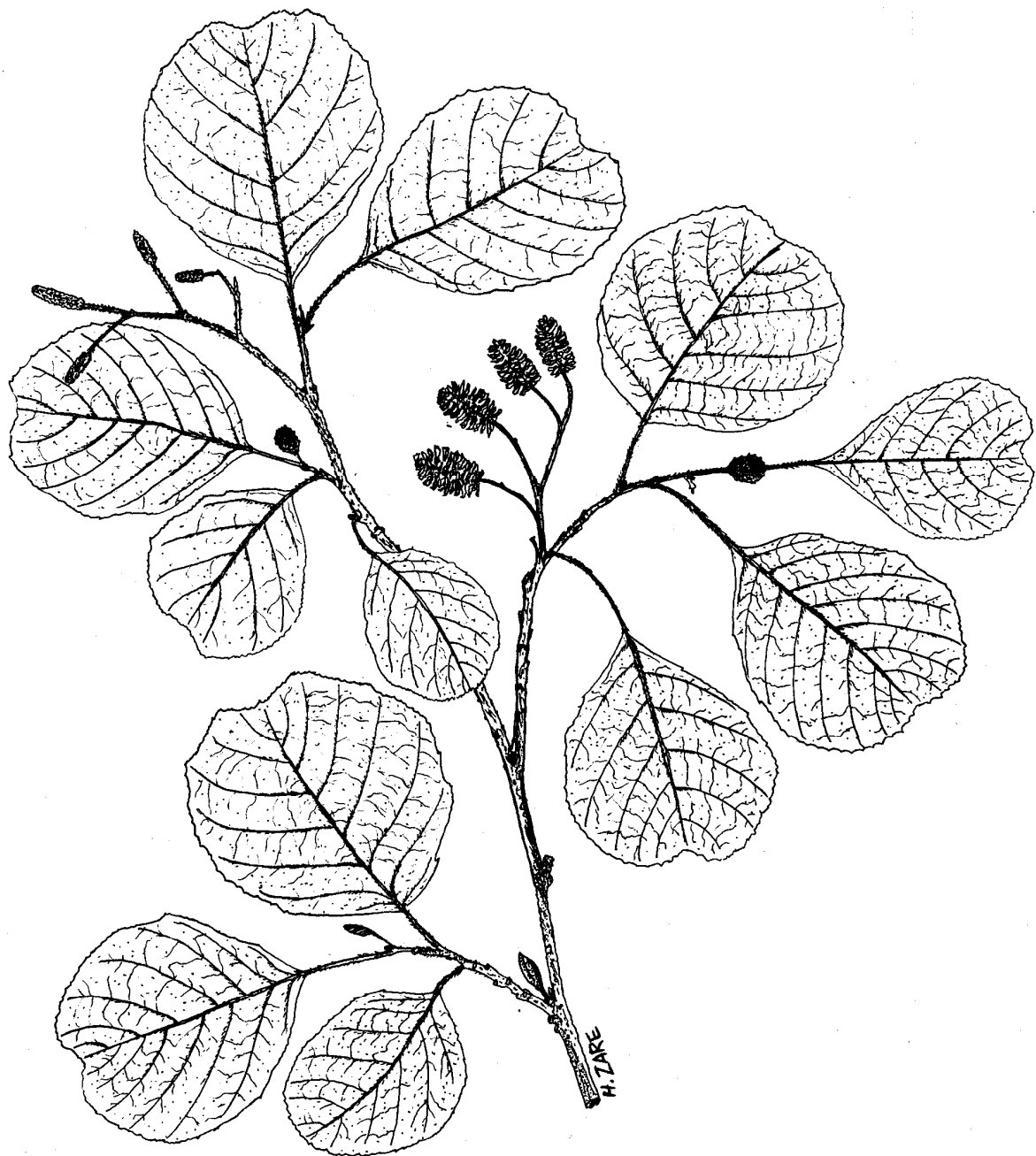


Fig. 2 *Alnus glutinosa* subsp. *glutinosa* ($\times 0.87$).

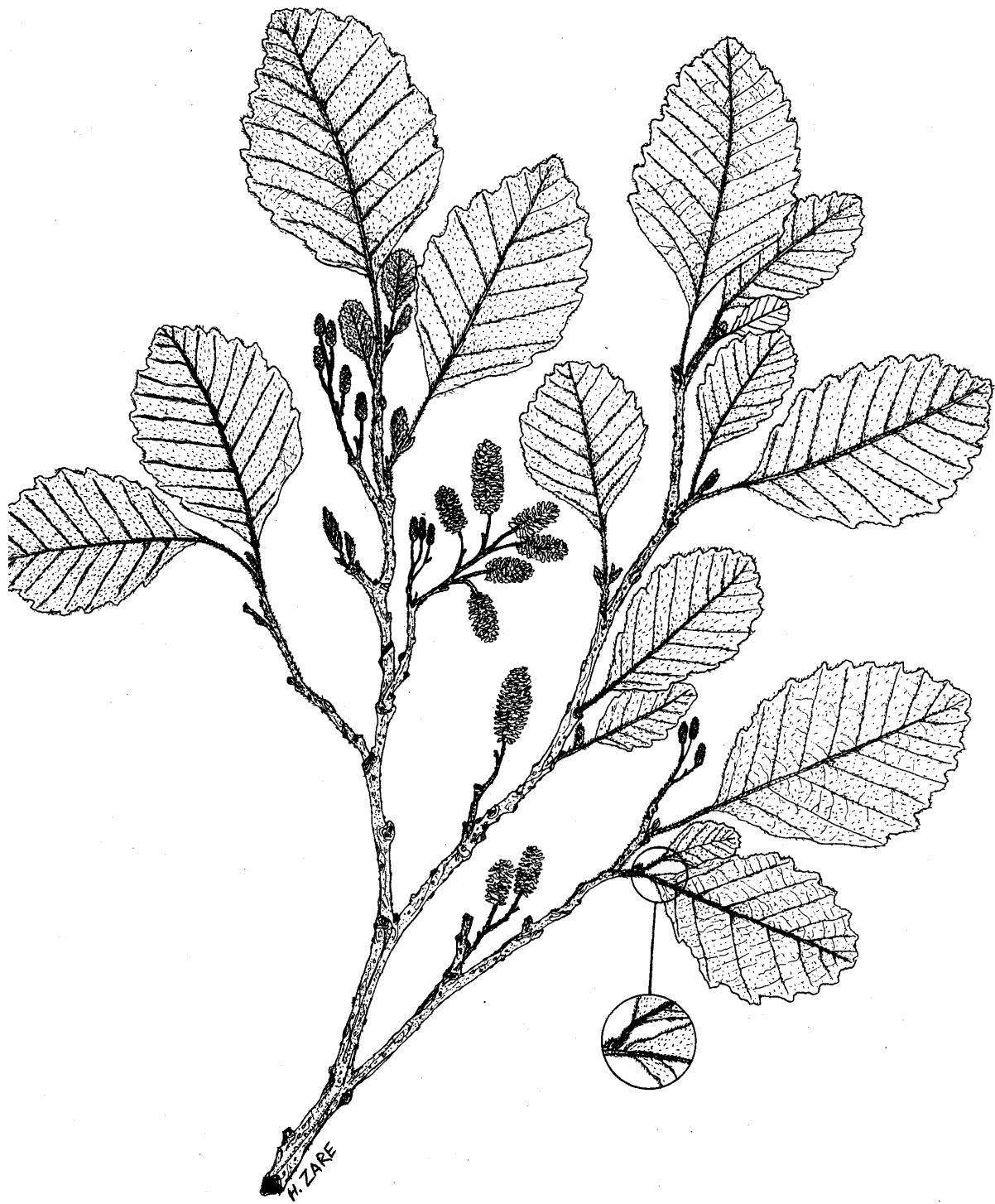


Fig. 3. *Alnus glutinosa* subsp. *antitaurica* ($\times 0.76$).

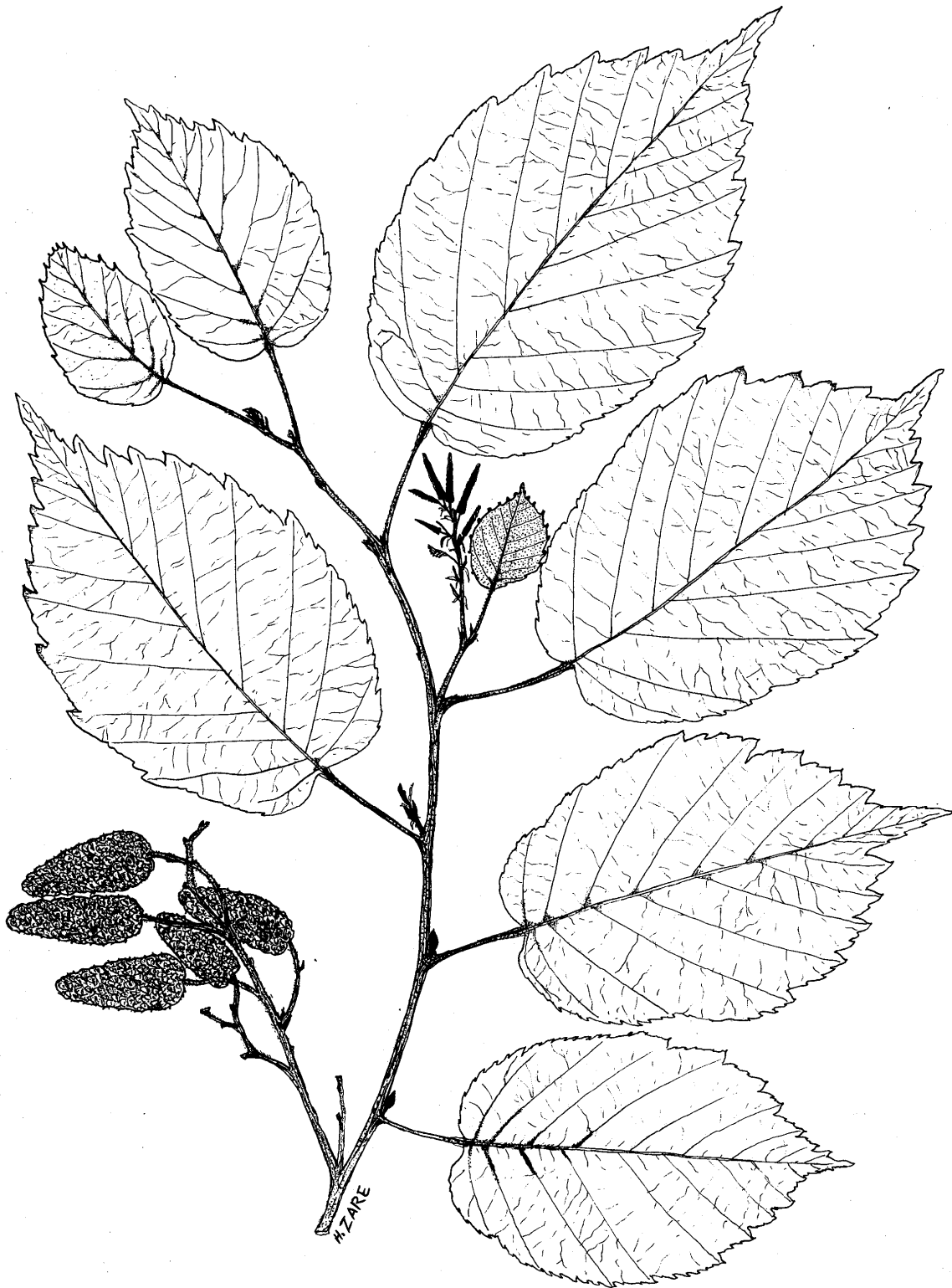


Fig. 4. *Alnus dolichocarpa* ($\times 0.67$).

Leaves ovate or slightly elliptic to rounded or at the end of twigs cuneate, slightly oblique, cordate at base, apex abruptly acuminate (long acuminate) or caudate, at 1/2 to 1/3 of upper margin with large triangular teeth with main vein reaching to the tip of teeth, in lower half serrate and sometimes undulate, 9-16 cm. long and 5-10 cm. broad, pale green and darkish, with outspread stomata or without them, glabrous or rarely with sparse hairs on the main veins, in beneath olive-green, glabrous or more or less hairy on the main veins, with axillary light brown tufts of hairs; veins 7-8 pairs, straight, prominent, reddish brown. Petioles puberulent, reddish at first, finally gray, 2-3 cm long. Male catkin 1-4, relatively short and thin, 2.5-4 cm. long. Female catkins red with relatively long stalk. Ripe fruits cone-shaped, slightly broad at base and rounded at apex, 3-4 cm. long and 1-2 cm. broad; immature fruit scales with distinct spiral shape spread toward the fruit apex; surface of scales with small dark-brown ligules; scales at the apex with 4-6 large teeth. Seeds elliptic and broad toward the tip, asymmetric and often prominent in one side; wings leathery and narrow, complete around the seed, light brown and dark at the tip. Male catkins burst time March to half first of April and fruits ripening in November.

Typus. Mazandaran: Nowshahr, Mashlak river bank, -20 m., Zare, 10565 (holotypus TARI; isotypus herbarium of Nowshahr Botanical Garden); same locality, Zare, 10564, margin of Mashlak river, -15 m., Zare and Amini, 7834, margin of Mashlak river near Maadan, -5 m., Zare and Amini, 10580; Tonekabon, Soleyman Abad to Aghoozhal forests, 1200 m., Zare and Amini, 10566.

Ecology. *Alnus dolichocarpa* grows on sandy soil in Mashlak river bank, from -20 m.a.s.l, along the river to the margin of Mashlak forest. In addition, it can be found in *Fagus orientalis* Lipsky and *Alnus subcordata* C. A. Mey. associations in Soleyman-Abad forest, south of Tonekabon. Permanent soil moisture along with drainage is a basic requirement. It prefers relatively durable water but less than that of *Alnus glutinosa* Gaertn. *Alnus dolichocarpa* is a relatively rare species and unlike the other species, cannot be found at all in the Hyrcanian lowland forest and coastal zone.

***Alnus djavanshirii* Zare, sp. nov. Fig. 5, Map 3.**

Affinis *Alnus orientalis* sed foliis anguste ellipticis, ad basem et apicem cuneatis, stomatibus supra et subtus paginas praeditis, ad marginem denticulatis mucronulatis, petiolis longis et flavis, glandibus brunneis petiolis, venis et ramis praeditis

Alnus djavanshirii is related to *A. orientalis* and it may be confused with *A. orientalis* by having non-cordate leaves at the base. It may be differentiated from *A. orientalis* by having long-elliptic leaves often cuneate at base and apex, stomata distributed on both leaf surfaces, leaf margin with tiny teeth or denticulate and often mucronulate, long and yellowish petiole, brownish glands on the petiole and veins as well as brittle and fragile grayish branches. Whereas in *A. orientalis* leaves are elliptic, ovate or sometimes long ovate, acuminate or abruptly long-acuminate and rarely obtuse at apex, rounded and sometimes cuneate, rarely cordate at base, double serrate at margin, petiole green-yellowish and without glands, branches rather flexible and none-fragile. This species is a rare with a limited geographical distribution and grows only in Dodangeh forest, south of Sari, northern Iran.

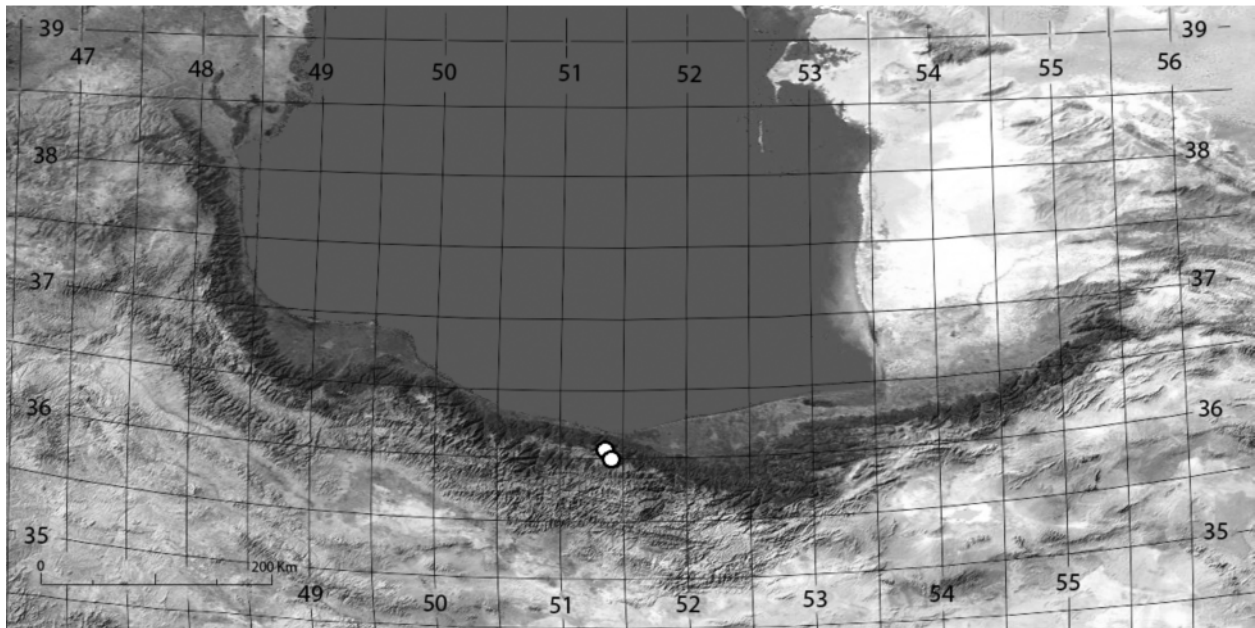
A big-size tree, 20-30 m high and more than 1 meter stem diameter; bark of trunk at first light gray, finally darkish, with longitudinal grooves and fissured; young branches olive-green at first finally becoming light gray, pubescent with white and permanent hairs, angular, with light brown prominent and often transversal lenticels, Winter buds with stalk and pubescent, long ovate, light brown, with resin secretion; leaves inside the buds open. Leaves elliptic rarely ovate, 2 times as long as broad, 6-13 cm long, 3-6 cm broad, acute or rarely acuminate at apex, cuneate or attenuate at base; at the margin with simple and very small teeth (serrulate) and slightly mucronate; upper surface glabrous and olive-green to grayish, with visible tiny lenticels; veins distinctly yellow; lower surface green-yellowish, glabrous except sparse hairs on the veins and axillary tufts; veins yellow, often straight, 8 pairs (10); main vein prominent with brownish glands; petiole yellow, pubescent, with brown glands, 2.5-4 cm long, 1/3 to 1/2 or longer than half of leaves length. Male catkins in clusters of 1-6, short with pubescent and gland-bearing stalk, 3-4.5 cm long and 0.5 cm broad. Fruit or strobiles globose or broadly ovate, 12-20 mm long and 10-18 mm broad (length and width almost equal); peduncle short and less than 6 mm or rarely 8 mm long. Seed narrowly oblong or flattened at the tip, glabrescent, 3-4 mm long, without wing, glossy and light brown. Male catkin burst time is February to March, fruit ripening in October.

Typus. Mazandaran: Sari, Dodangeh, Moola village forest, 1100 m, Zare, Amini, 10547 (holotypus TARI; isotypus herbarium of Nowshahr Botanical Garden; same region, 1120 m, Zare and Amini and Ejtehad, 12555.

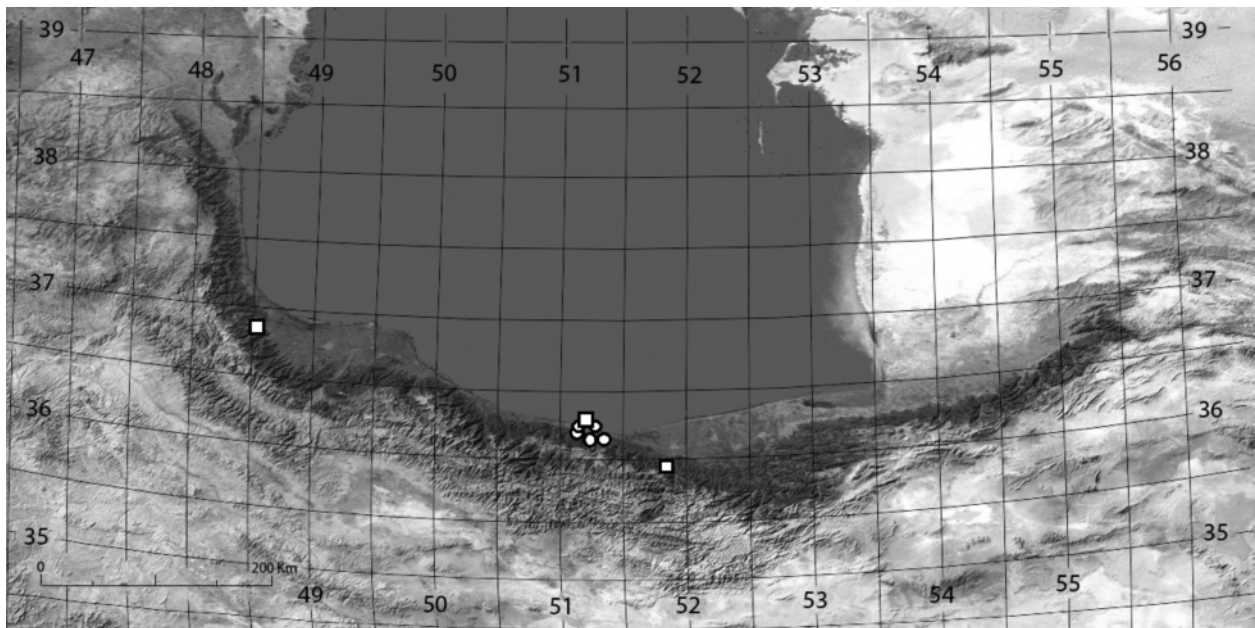
Ecology. *Alnus djavanshirii* is a very rare species that can only be seen in Dodangeh region, south of Sari, northern Iran. It grows at elevation of 1000 m.a.s.l, in



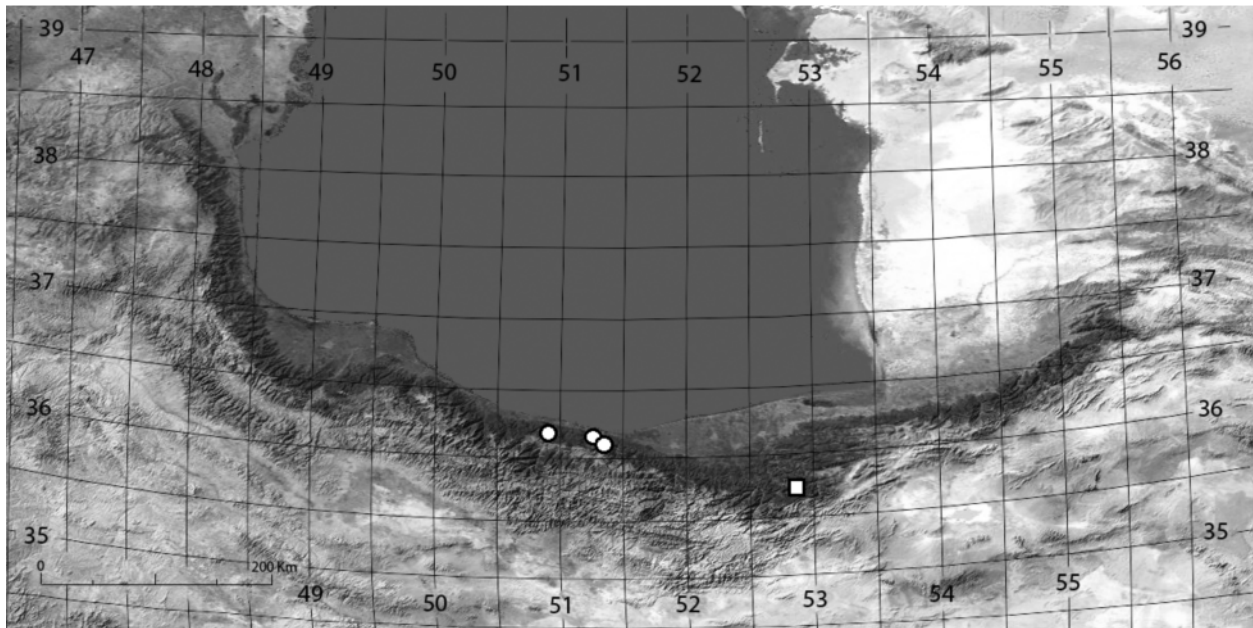
Fig. 6. *Alnus djavanshirii* ($\times 0.87$).



Map 1. Distribution of *Alnus orientalis*.



Map 2. Distribution of *Alnus glutinosa* subsp. *glutinosa* ○ and subsp. *antitaurica* □



Map 3. Distribution of *Alnus djavanshirii* □ and *Alnus dolichocarpa* ○

Carpinus betulus mixed stand wherever this species is mixed with *Acer cappadocicum* Gled., *Zelkova carpinifolia* (Pall.) Dipp., *Crataegus melanocarpa* M. B., *Crataegus microphylla* C. Koch., *Parrotia persica* (DC.) C. A. Mey. and *Acer velutinum* Boiss. *Alnus djavanshirii* is dependent on moisture soil with adequate humus layer and usually grows on brown forest soil and expands its branches very fast. The young twigs and branches are often very fragile. This species, in its various growth stages, needs moderate forest light except in seedling stage that complete light is necessary particularly in degraded and moistured soils.

The species named in the honor of late professor Dr. Djavanshir, dendrologist in University of Tehran, Faculty of Natural Resources.

Key to *Alnus* species in Iran

- 1- Juvenile leaves in winter buds open. Midrib of leaf straight or arcuate; leaves with ± small teeth at the margin, without lobes or large teeth 5
- Juvenile leaves in winter buds folded. Midrib of leaves straight; margin of leaves with large teeth or rather lobed especially in upper half 2
- 2- Leaf apex long-acuminate or caudate; margin of leaves in upper half with large and triangular teeth. Fruit large, 25 to 40 mm. long **A. dolichocarpa**

- Leaf apex rounded, rarely with small tip or retuse; margin of leaves in upper half with irregularly broad triangular teeth. Fruit small, 8 to 18 mm long (**A. glutinosa**) 3

- 3- Leaves elliptic to oblong, denticulate, acute or acuminate, with 8-11 pairs of veins, pubescent only on the veins **subsp. barbata**

- Leaves ovate rarely elliptic, retuse or obtuse at the apex, with 4-8 (9) pairs of veins; lower surface densely or slightly pubescent 4

- 4- Twigs and petiole more or less glabrescent. Leaves ovate, dark green, on both surfaces glabrous except for sparse hairs on the veins and axillary tufts

- Twigs and petiole more or less tomentose. Leaves elliptic, green grayish, on both surfaces pubescent especially in juvenile or at least densely along the veins **subsp. glutinosa**

- 5- Leaf midrib curved or arcuate; leaf base often cordate, rarely rounded. Young twigs, petiole and under leaf often pubescent **subsp. antitaurica**

- Veins straight; leaf base often rounded, rarely acute. Young twigs, petiole and under leaf often glossy **A. subcordata** 6
- 6- Margin of leaves with simple and very small teeth (serrulate). Fruit globose **A. djavanshirii**

- Margin of leaves distinctly and rather largely double-serrate. Fruit ovate **A. orientalis**

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