

Five new records and two new reports of *Cotoneaster* Medik. (Rosaceae) for the Flora of Iran

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diff.pub@mnhn.fr / <http://sciencepress.mnhn.fr>

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ISSN (imprimé / print): 1280-8571/ ISSN (électronique / electronic): 1639-4798

Five new records and two new reports of *Cotoneaster* Medik. (Rosaceae) for the Flora of Iran

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Submitted on 30 May 2021 | accepted on 19 October 2021 | published on 17 May 2022

Raei Niaki N. A., Attar F., Zamani A., Maroofi H. & Joharchi M. R. 2022. — Five new records and two new reports of *Cotoneaster* Medik. (Rosaceae) for the Flora of Iran. *Adansonia*, sér. 3, 44 (14): 141-152. <https://doi.org/10.5252/adansonia2022v44a14>. <http://adansonia.com/44/14>

ABSTRACT

Cotoneaster Medik. is an important and taxonomically complex group due to numerous and variable forms. Therefore, it is an interesting object for taxonomical studies. Five new records, including *Cotoneaster transcaucasicus* Pojark., *C. minutus* G. Klotz, *C. afghanicus* G. Klotz, *C. aitchisonii* C. K. Schneid., *C. ellipticus* Hort ex Loudon are identified for the first time from Iran. Moreover, *C. meyeri* Pojark. and *C. insignis* Pojark. are reported for the second time for the Flora of Iran and for the first time based on exact location and sample collection. These taxa are compared with their closest relatives. A morphological key, taxonomic treatment, color photographs, and distribution map are provided for the mentioned species. All the introduced species belong to Irano-Turanian region or ecotones of Irano-Turanian and Eurosiberian regions.

RÉSUMÉ

Cinq enregistrements et deux signalements nouveaux du genre Cotoneaster Medik. (Rosaceae) de la Flore d'Iran. *Cotoneaster* Medik. est un groupe important et complexe sur le plan taxonomique en raison de ses formes nombreuses et variables. De ce fait, il constitue un objet intéressant pour les études taxonomiques. Cinq nouveaux signalements, dont *Cotoneaster transcaucasicus* Pojark., *C. minutus* G. Klotz, *C. afghanicus* G. Klotz, *C. aitchisonii* C. K. Schneid, *C. ellipticus* Hort ex Loudon sont identifiés pour la première fois en Iran. De plus, *C. meyeri* Pojark. et *C. insignis* Pojark. sont signalés pour la deuxième fois dans la Flore d'Iran et pour la première fois sur la base de la localisation exacte et de la collecte d'échantillons. Ces taxons sont comparés à leurs plus proches parents. Une clé morphologique, un traitement taxonomique, des photographies en couleur et une carte de distribution sont fournis pour les espèces mentionnées. Toutes les espèces introduites appartiennent à la région irano-touranienne ou aux écotones des régions irano-turaniennes et eurosibériennes.

KEY WORDS

Rosaceae,
Cotoneaster,
Iran-Turanian,
phytogeography,
identification key,
new records.

MOTS CLÉS

Rosaceae,
Cotoneaster,
Irano-touranien,
phytogéographie,
clé d'identification,
signalements nouveaux.

INTRODUCTION

Cotoneaster Medik. is a genus of Rosaceae Juss. family (Potter *et al.* 2007), with approximately 400 species of evergreen or deciduous shrubs (Fryer & Hylmö 2009). High diversity of *Cotoneaster* has been reported in Himalayas and China (Dickore & Kasperek 2010), but also occurs in northern temperate regions and North Africa (Fryer & Hylmö 2009; Boer 2014). It occurs in mountains, forests, river valleys, and banks (Lu & Brach 2003).

Because of some processes such as interspecific hybridization, apomixis and phenetic plasticity, *Cotoneaster* is a complex genus, with several species difficult to identify. Accordingly, practical identifications in herbarium collections and regional inventories are very difficult and often lead to erroneous results (Fryer & Hylmö 2009; Li *et al.* 2014). The genus is classified into two subgenera based on petals features (Koehne 1893): *Cotoneaster* and *Chaenopetalum* Koehne. In subgenus *Cotoneaster*, the flowers open successively over an extended period, and the petals are erect or suberect (Koehne 1893), while in *Chaenopetalum*, the flowers within a cyme open simultaneously, and the petals spread or rarely semi-spread. The monophyly of these subgenera are supported by phylogenetic studies (Li *et al.* 2014).

Until now, a few comprehensive studies have been conducted on the taxonomy of the genus in Iran (Riedl 1969; Khatamsaz 1992; Raei Niaki 2019). According to earlier studies, *Cotoneaster* consists of 14 (Riedl 1969) to 19 species in Iran (Khatamsaz 1992). To these Raei Niaki *et al.* (2019), added two new species, (*C. nima-yushiji* R. Niaki & Attar and *C. mazandaranicus* R. Niaki & Attar).

The present research aims to update the list of *Cotoneaster* taxa for the flora of Iran.

MATERIAL AND METHODS

DATA COLLECTION

In the study framework on the genus *Cotoneaster*, some herbarium specimens were observed which were not compatible with any previously identified species from Iran (Fig. 1).

About 500 specimens were collected from different regions of Iran during about 14 years. They were studied in detail as herbarium specimens using some type specimens, specially deposited in the Herbarium of Vascular Plants of the Komarov Botanical Institute (LE, Acronyms according to Thiers 2021).

IDENTIFICATION KEY BASED ON MORPHOLOGICAL CHARACTERS OF THE NEW RECORDS AND REPORTS OF *COTONEASTER* MEDIK. SPECIES PLUS THEIR CLOSEST RELATIVES

1. Leaves often more than 15 mm 2
- Leaves often less than 15 mm 9
2. Lower leaf surface glabrous 3
- Lower leaf surface tomentose 4
3. Leaves base broadly cuneate, apex obtuse to rounded upper surface light green, fruit light red
..... *Cotoneaster multiflorus* Bunge
- Leaves base narrowly cuneate, apex obtuse to rounded upper surface dark green, fruit purple-black
..... *Cotoneaster meyeri* Pojark.
4. Leaves long elliptic, long ovate or obovate (length of leaves more than 1.5 × width of leaves) 5
- Leaves broadly elliptic to suborbicular (length of leaves less than 1.5 × width of leaves) 6
5. Leaves elliptic-rhombic, apex obtuse, fruit black *Cotoneaster suavis* Pojark.
- Leaves obovate, apex rounded to truncate, fruit rich red *Cotoneaster aitchisonii* C.K.Schneid.
6. Fruit red, petioles often ≤ 5 mm 7
- Fruit dark purple to black, petioles often ≥ 6 mm 8
7. Leaves obovate to elliptic, sepals erect, tomentose *Cotoneaster transcausicus* Pojark.
- Leaves obovate to ovate, sepals flat, subglabrous *Cotoneaster nummularius* Fisch. & C.A.Mey.
8. Leaves elliptic-rhombic, base cuneate, lax inflorescence, fruit obovate to globose ... *Cotoneaster insignis* Pojark.
- Leaves elliptic-orbicular, base rounded to obtuse, compact inflorescence fruit globose
..... *Cotoneaster ellipticus* (Lindl.) Loudon
9. Leaves mostly long ovate or long elliptic 10
- Leaves mostly wide elliptic to orbicular 11
10. Leaves base obtuse to rounded, apex acute to obtuse *Cotoneaster persicus* Pojark.
- Leaves base cuneate to broadly cuneate, apex rounded *Cotoneaster afghanicus* G.Klotz
11. Leaves broadly elliptic, fruit black, pedicels up to 4 mm *Cotoneaster kotschyi* G.Klotz
- Leaves orbicular, fruit light red, pedicels up to 2 mm (sometime without pedicels)
..... *Cotoneaster minutus* G.Klotz

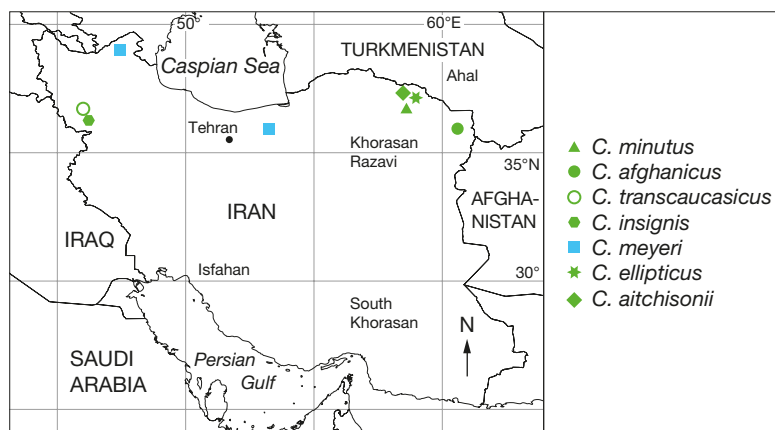


FIG. 1. — Map showing location of new records and reports of *Cotoneaster* species in Irano-Turanian (green symbols) and ecotones between Irano-Turanian and Eurosiberian regions (blue symbols).

The new records were deposited in Tehran University (TUH), Kurdistan Agricultural and Natural Resources Research and Education Center (HKS), and Ferdowsi University of Mashhad (FUMH) herbaria. Plant specimens were identified using *Flora of USSR* (Pojarkova 1971), *Flora Iranica* (Riedl 1969), *Flora of Iran* (Khatamsaz 1992), and *Flora of Turkey* (Browicz 1972) and the comprehensive monograph of *Cotoneaster* (Fryer & Hylmö 2009).

IDENTIFICATION

The diagnostic characters for the delimitation of *Cotoneaster* species are the following: foliage persistence; leaf size, shape and indumentum type; length of fertile shoots; the number of flower in the cyme; petal orientation and color; nutlet number; fruit color and indumentum.

NEW RECORDS

Based on the current study, *Cotoneaster transcaucasicus*, *C. minutus*, *C. afghanicus*, *C. aitchisonii*, *C. ellipticus* are introduced for the first time from Iran. In addition, *C. meyeri* and *C. insignis* were identified for the second time for flora of Iran. This current work added new records and reports to the Flora of Iran, and the total number of *Cotoneaster* species has increased to 28.

Family ROSACEAE Juss.
Genus *Cotoneaster* Medik.

Cotoneaster transcaucasicus Pojark.
(Fig. 2)

Botanicheskogo Instituta Imeni V. L. Komarova Akademii Nauk SSSR, Leningrad [St. Petersburg] 21: 162, t. 1 (Pojarkova 1961).

TYPUS. — Armenia, Mergi, between Lischk and Pirmazra; *Pojarkova* 733 (holo-, LE).

SPECIMENS EXAMINED. — Iran. Province Kurdistan, Baneh, Kanibard village, 15.IX.2006, *Maroofi & Mansoori* 8428 (HKS); Baneh to

Sardasht, toward to Bolhasan village, 21.X.2003, *Maroofi & Naseri* 6520 (HKS); c. 35 km from west of Baneh to Sardasht, Namazgah village, 10.X.2005, *Maroofi & Mansoori* 7557 (HKS).

NOTE

According to Browicz 1972, this species which is distributed in Armenia and northeast Turkey, was observed among herbarium specimens at HKS (Fig. 2A). *C. transcaucasicus* is the closest relative of *C. nummularius* Fisch. & C.A.Mey. (Browicz 1972). Generally, these species have some similarities in features of leaves (size) fruit color (red), calyx orientation, indumentum of all parts except in sepals. On the other hand, there are a few remarkable differences between these species: *C. transcaucasicus* is distinguished by obovate leaves with cuneate base and widely rounded-emarginate apex (Fig. 2B) and tomentose sepals in fruit from *C. ellipticus* with elliptic-ovate leaves widely cuneate to rounded base, obtuse apex and glabrous sepals.

Cotoneaster minutus G.Klotz
(Fig. 3)

Wissenschaftliche Zeitschrift der Martin-Luther-Universität Halle-Wittenberg, Mathematisch-Naturwissenschaftliche Reihe, Halle 12: 763 (Klotz 1963).

TYPUS. — Kashmir. Near Chara-i-Sharif, Srinagar, 25.X.1962, *H. Meusel s.n.* (holo-, HAL).

SPECIMENS EXAMINED. — Iran. Province Khorassan, Bojnord, Ghorkhod protected region, 37°23'46"N, 56°27'47"E, 1660 m, 20.IX.2011, *Memariani & Arjmandi* 44626 (FUMH).

NOTE

This species is morphologically close to *C. kotschyi* (C. K. Schneid.) G. Klotz. The latter species is widely distributed in Iran (Riedl 1969; Khatamsaz 1992). However, *C. minutus* differs from the *C. kotschyi* by the small (up to 7 mm vs 6-14 mm in length) and orbicular leaves (vs elliptic-ovate) and the light red fruits (vs black-purple) (Fig. 3A, B). This species occurs in Afghanistan, Kashmir (Fryer & Hylmö 2009) and Iran.



FIG. 2. — *Cotoneaster transcaucasicus* Pojark.: A, habit; B, leaves and fruits. Collection number: *Maroofi & Naseri 6520* (HKS); determined by Raei Niaki & Attar.



FIG. 3. — *Cotoneaster minutus* G.Klotz leaves and fruits outline (A) and close up (B). Collection number: Memariani & Arjmandi 44626 (FUMH); determined by Raei Niaki & Attar.

Cotoneaster afghanicus G.Klotz
(Fig. 4)

Wissenschaftliche Zeitschrift der Martin-Luther-Universität Halle-Wittenberg, Mathematisch-naturwissenschaftliche Reihe, Halle 15: 532 (Klotz 1966).

TYPUS. — **Afghanistan**. Kuram Valley, XII.1879, *J. E. T. Aitchison* 363 (holo-, DD; iso-, A, BM, CAL).

SPECIMENS EXAMINED. — **Iran**. Province Khorasan, Bazangan, 37°76'46"N, 56°43'40"E, 1500 m, 06.VI.1996, *Faghiniya & Zangoeei* 27111 (FUMH); Bazangan, 36°16'44"N, 60°23'38"E, 1480 m, 25.VIII.2009, *Jobarchi & Arjmandi* 43318 (FUMH); West of Bojnord, Ghorkhod protected region, 37°23'46"N, 56°27'47"E, 1660 m, 20.IX.2011, *Memariani & Arjmandi* 44626 (FUMH).

NOTE

This species is morphologically close to *C. persicus* Pojark. (Raei Niaki 2019) The latter is widely distributed in Fars, Isfahan, and Kerman provinces (Khatamsaz 1992). Leaves of both species are small and ovate with red fruits. However, *C. afghanicus* differs from *C. persicus* in its obtuse to rounded apex of leaves (vs acute), base of leaves rounded to obtuse (vs cuneate to narrowly cuneate), and 1-4 flowers per inflorescence (vs 5-8 flowers) (Fig. 4A, B). This species occurs in Afghanistan, Kashmir (Fryer & Hylmö 2009) and Iran.

Cotoneaster aitchisonii C.K.Schneid.
(Fig. 5)

Illustriertes Handbuch der Laubholzkunde, Band 1: 749 (Scheiner 1906).

TYPUS. — **Afghanistan**. Kuram district, 5.VII.1880, *J. E. T. Aitchison* 277 (lecto-, K; iso-, A).

SPECIMENS EXAMINED. — **Iran**. Province Khorasan, Bojnord, 37°50'31"N, 57°31'25"E, 1593 m, 03.X.2009, *Memariani, Zangoeei & Arjmandi* 43351, 43353 (FUMH); Chenaran, Ferizi, 36°4'49"N, 58°4'43"E, 2050 m, 31.X.2009, *Arjmandi & Zangoeei* 43442 (FUMH).

NOTE

The closest morphologically relative of *C. aitchisonii* is *C. suavis* Pojark. (Raei Niaki 2019). They share many similar characters, e.g., habit, the large leaves with a villose lower surface, long petiole (c. 4-12), dense inflorescence (7-15 flowers), and navel open in fruit. *C. aitchisonii* can be readily separated from *C. suavis* by its obovate leaves (vs elliptic-rhombic), leaves apex rounded to acute (Fig. 5A, B) (vs obtuse), red fruit (vs black), succulent fruits of 7-10 mm diam., (vs non-succulent of 6-8 mm diam. fruit) (Fig. 5). This species occurs in Afghanistan, Pakistan, Kashmir (Fryer & Hylmö 2009) and Iran.

Cotoneaster ellipticus Hort ex Loudon
(Fig. 6)

An Encyclopædia of Plants [2nd ed]: 1208 (Loudon 1841).

TYPUS. — **Kashmir**. Waziristan, *J. L. Stewart* 274b (lecto-, K).

SPECIMENS EXAMINED. — **Iran**. Khorasan, Bojnord, 1593 m, 37°50'31"N, 57°31'25"E, 03.X.2009, *Memariani, Zangoeei & Arjmandi* 43358 (FUMH); West of Bojnord, 37°26'39"N, 56°47'06"E, 1425 m, 09.VIII.2008, *Memariani, Zangoeei & Arjmandi* 41331 (FUMH).

NOTE

The closest relative of this species is *C. insignis*. *C. insignis* is diagnosed by having elliptic-obovate leaves, 30-60 × 20-40 mm, base widely to narrowly cuneate, upper surface mid-green; petiole 5-10 mm; lax inflorescence, 6-20-flowered inflorescence and peduncle up to 20 mm. While *C. ellipticus* is distinguished by having orbicular-elliptic leaves (20-40 × 20-34 mm), base widely obtuse to rounded, upper surface dark bluish green; petiole 4-7 mm; compact inflorescence, 5-13-flowered inflorescence and peduncle up to 9 mm (Fig. 6). This species occurs in Pakistan, Kashmir (Fryer & Hylmö 2009) and Iran.

Cotoneaster meyeri Pojark.
(Fig. 7)

Botanicheskogo Instituta Imeni V. L. Komarova Akademii Nauk SSSR, Leningrad [St. Petersburg] 17: 185 (Pojarkova 1955).

TYPUS. — **Azerbaijan**. *In vicinitate urbis Kirovabad (Gandsha) ad ripam dextram fluvii Kjurai-Czai s.d.*, *Pojarkova* 289 (holo-, LE).

SPECIMENS EXAMINED. — **Iran**. Province East Azerbaijan, Arasbaran protected area, Kalaleh village, Soulidareh, 38°57'1"N, 46°44'4"E, 800 m, 26.VII.1993, *Ghabremani & Talebpur* 2770 (Herbarium of Tabriz). — Province Mazandaran, 7 km after Pole-Zanguleh to Chalus, 36°13'28"N, 51°18'18"E, 2028 m, 24.V.2016, *Raei Niaki & Mahdigholi* 46883 (TUH).

REMARK

C. meyeri is reported from north Iran in Mazandaran province (Fig. 7A). The species belongs to subgenus *Chaenopetalum* (Fryer & Hylmö 2009). This species is related to *C. multiflorus* Bunge (Browicz 1972), from which it differs for its black-purple fruits (vs light red to red), acute to obtuse (vs obtuse to rounded) and shorter leaves (15-39 mm vs 20-55 mm), fewer-flowered inflorescence (5-8 vs 5-13) and indumentum of pedicel in fruit (glabrous vs thinly tomentose) (Fig. 7B). The geographical distribution of the species is Afghanistan, Tajikistan, Kyrgyzstan, Azerbaijan (Riedl 1969; Pojarkova 1971; Fryer & Hylmö 2009) and Iran.

NOTE

C. meyeri was not previously reported from the flora of Iran (Riedl 1969). Later, this species was reported there without locality information (Fryer & Hylmö 2009). In the framework of this paper, this species was collected again, and it is reported for Flora of Iran.



FIG. 4. — *Cotoneaster afghanicus* G.Klotz leaves and fruits outline (A) and close up (B). Collection number: *Faghihnia & Zangooei* 27111 (FUMH); determined by Raei Niaki & Attar.



FIG. 5. — *Cotoneaster aitchisonii* C.K.Schneid. outline (A) and close up of leaves (B) and fruit (C). Collection number: Memariani, Zangoeei & Arjmandi 43351 (FUMH); determined by Raei Niaki & Attar.



FIG. 6. — *Cotoneaster ellipticus* (Lindl.) Hort ex Loudon outline (A) and close up of leaves (B) and fruit (C). Collection number: Memariani, Zangoeei & Arjmandi 43358 (FUMH); determined by Raei Niaki & Attar.



FIG. 7. — *Cotoneaster meyeri* Pojark. leaves and fruits outline (A) and close up (B). Collection number: *Raei Niaki & Mahdigholi 46883* (TUH); determined by Raei Niaki & Attar.

Cotoneaster insignis Pojark.

(Fig. 8)

Flora URSS (Flora Unionis Rerumpublicarum Sovieticarum Socialistarum) 9: 330 (Pojarkova 1939).

TYPE. — Described after a cultivated specimen (probably from Kashmir) (holo-, LE).

SPECIMENS EXAMINED. — Iran. Province Kurdistan, west of Baneh to Sardasht, Namazgah village, 16.X.2006, *Maroofi & Mansoori* 8757 (HKS); west of Baneh to Sardasht, Namazgah village, 36°04'N, 45°42'E, 1591 m, 18.VIII.2007, *Attar, Raei Niaki & Zamani* 37454 (TUH).

REMARK

Reviewing different plants collected from Kurdistan province, *C. insignis* is reported as a new record from Iran (Fig. 8A). The species belongs to subgenus *Chaenopetalum* (Fryer & Hylmö 2009). As noted above, *C. insignis* and *C. ellipticus* are closest relatives. Other than morphological differences, these species are geographically distinct. So, *C. insignis* occurs in west of Iran, while *C. ellipticus* occurs in the northeast of Iran. Consequently, the morphological differences and the discontinuous distribution provide sufficient evidence for treating *C. ellipticus* and *C. insignis* as separate species. The geographical distribution of the *C. insignis* is Afghanistan, Kyrgyzstan, Azerbaijan, Tajikistan, India, northwestern Himalaya (Riedl 1969; Pojarkova 1971; Fryer & Hylmö 2009) and west of Iran.

NOTE

This species has been reported from Iran without mention of the locality (Riedl 1969). So, this species was not verified as a native species for Iran (Khatamsaz 1992). However, this species was found from west Iran and is introduced as a new record based on the collected data.

DISCUSSION

With more than 8000 reported and about 2500 (sub) endemic taxa, Iran has a rich flora (Ghahreman & Attar 1999). Until now, many floristic studies have led to the identification of new species or new records from different localities of Iran. The presence of different climates involves three different phytogeographical regions in the country: the Irano-Turanian (green symbols in Fig. 1), the Saharo-Sindian and the Euro-Siberian (blue symbols in Fig. 1; White & Léonard 1991), two biodiversity hotspots (Irano-Anatolian and Caucasus) and five areas of endemism are recognized for Iran (Noroozi *et al.* 2019). Most of the endemic taxa of Iran occur in alpine zones of Irano-Turanian region.

Rosaceae is among the 10 richest families of Iran regarding endemism rate with 69 taxa (Noroozi *et al.* 2019) from more than 240 taxa (Ghahreman & Attar 1999). Among the 28 reported species of *Cotoneaster*, five species (*C. as-*



FIG. 8. — *Cotoneaster insignis* Pojark. leaves and fruits outline (A) and close up (B). Collection number: Attar, Raei Niaki & Zamani 37454 (TUH); determined by Raei Niaki & Attar.

sadii Khat., *C. esfandiarii* Khat. and *C. persicus* Pojark., *C. nima-yushiji* and *C. mazandaranicus*) are endemic to Iran. Phytogeographically, most species belong to Irano-Turanian region in west and northwest and ecotone parts between Irano-Turanian and Euro-Siberian regions as the continuous line throughout northeast to northwest (Raei Niaki *et al.* 2009). A few species such as *C. kotschyi* and *C. nummularioides* are distributed in all phytogeographical regions of Iran. Interestingly, the remarkable number of Iranian *Cotoneaster* species occurs in Caucasus hotspot in Arasbaran region. In this small forest region in northwest of Iran, a high level of biodiversity can be recognized for tree and shrubby genera of Rosaceae such as *Pyrus* L. and *Crataegus* L.

As seen on the Fig. 1, all the introduced records and reports of *Cotoneaster*, belong to the mountainous ranges of Irano-Turanian region, except for *C. minutus*, which has been collected from ecotones between Irano-Turanian and Euro-Siberian regions. These species have been found only in a few localities in Iran by the authors. However, it is expected additional individuals of them to be found in future, because these species exhibit distribution range in the adjacent countries.

Acknowledgements

This study did not receive any grants or funding. Thierry Deroin and an anonymous referee are thanked for their remarks, which help to improve the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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Submitted on 30 May 2021;
 accepted on 19 October 2021;
 published on 17 May 2022.