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Ecological distribution study of wild pistachios for selection of rootstock

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SUMMARY – The main origin of pistachio is the Iran plateau. There are pistachio forests in the west, east, south and centre of the country, and composed of three species: *P. vera*, *P. atlantica* and *P. khinjuk*. In this research work, we have tried to study the distribution of different species related to ecological factors in different parts of Iran. By contacting four different herbaria and visiting different parts of Iran, we collected specimens of pistachios. Also by using different geological and ecological maps, we tried to compose several new geo-ecological maps of the distribution of the pistachio in the country. We considered different factors, such as the minimum and maximum temperatures, the amount of rain, the climate and the height of the regions. Using this new information, we could select the wild species that are most resistant to harsh conditions, like dry weather and salinity, etc., in order to choose resistant rootstocks. These rootstocks will grow better and will live longer. This study suggests that *P. khinjuk* could be the best rootstock for most regions in Iran.

Key words: *Pistacia vera, P. Khinjuk, P. atlantica*, subsp. *mutica*, subsp. *kurdica*, subsp. *cabulica*, distribution, ecology, Iran.

RESUME – *"Etude de la distribution écologique des pistachiers sauvages pour la sélection de porte-greffes". L'origine des pistachiers est le plateau d'Iran. Les forêts de pistachiers se trouvent à l'est, l'ouest, le sud, et le centre du pays, et sont composées de 3 espèces :* Pistacia vera*,* P. Khinjuk *et* P. atlantica*. Dans cette recherche nous avons essayé d'étudier la distribution de différentes espèces en relation avec les facteurs écologiques dans différentes régions de l'Iran. Nous avons étudié les échantillons de quatre herbiers, et nous avons voyagé dans toutes les forêts de l'Iran. Nous avons collecté tous les spécimens de pistachiers sauvages. En utilisant les cartes géologiques, et écologiques, nous avons essayé de préparer les nouvelles cartes géoécologiques pour la distribution des pistachiers du pays. Nous avons considéré les températures maximales et minimales, la quantité de pluie, le climat et l'altitude de la région comme différents facteurs. En utilisant les informations, nous avons pu sélectionner l'espèce la plus résistante en situation difficile, comme la sécheresse et la salinité, etc. pour choisir le pied le plus résistant. Ce nouveau pied va mieux croître et va vivre plus longtemps. Dans cette recherche nous proposons* P. Khinjuk *comme le meilleur pied pour la plupart des région de l'Iran.*

Mots-clés : Pistacia vera*,* P. Khinjuk*,* P. atlantica*, ssp.* mutica*, ssp.* kurdica*, ssp.* cabulica*, distribution, écologie, Iran.*

Introduction

The genus *Pistacia* L. is dioecious and deciduous and belongs to the family *Anacardiaceae.* Among 15 known species of pistachios, only 3 species grow in Iran, including *Pistacia vera* L.1753, *Pistacia Khinjuk* Stocks 1952 and *Pistacia atlantica* Desf 1800*.* They are the most important species of pistachio and for this reason, Iran is known as the origin of pistachios. The word of pistachio is derived its Persian name: "pisteh" (Abrishami, 1995). Iran's pistachio forests are mostly accompanied with wild almond and other species of trees. However, they sometimes occur as pure population or a mixed of two species or sub-species in the same forest. Rechinger (1969) and Khatamsaz (1978) recognized 3 species for Iranian pistachios. These authors described 3 sub-species for *Pistacia atlantica: mutica, kurdica and cabulica*: (i) *Pistacia atlantica* Desf. subsp. *cabulica* (Stocks) Rech. F. 1969; (ii) *Pistacia atlantica* Desf. subsp. *kurdica* (Zohary) Rech. F. 1969; and (iii*) Pistacia atlantica* Desf. subsp. *mutica* (Fish and May) Rech. F. 1969.

Six hundred years ago the wild *P. vera* was transported from northeast forests for cultivation in Kerman and Raphsanjan. According to Abrishami (1995), the orchards of pistachio in these regions are only 70-80 years old, during which regional gardeners selected the horticultural cultivars of pistachios. Today, about 40 cultivars of domestic pistachios are cultivated in Iran.

Now some *P. vera* cultivars and especially small amygdalus type of pistachios such as Ghazvini are used as the nut rootstocks in Iran. Until now, here is no fundamental research about the production of new resistant rootstocks. The cultivars of *P. vera* are not resistance rootstocks to draught and gomosis disease (Sheibani, 1990). The wild pistachios were used as rootstocks in other countries as well (Parfitt *et al*., 1994; Ferguson *et al.,* 2001; Kaska and Nikpeyma, 2001). By considering this fact, we have tried to distinguish the most resistant species related to ecological distribution of pistachio forests. We considered ecological factors such as dryness, temperature, altitude, and diseases. These rootstocks can be used in future for production of stronger and more fertile trees.

Materials and methods

Different species of wild pistachios have been collected considering different ecological factors in different regions of Iran, using the following methods:

(i) Referring to four main herbariums in Iran and taking a list from all collected species during the past 50 years. These herbariums were:

- The herbarium of the Agricultural Faculty of the Tehran University.
- The herbarium of the Ministry of Agriculture.
- The central herbarium of the Tehran University.
- The herbarium of the investigation organization of forests and pastures.

(ii) Travelling to all-important forests in Iran located at the east, west, south and the centre of Iran in order to collect new specimens and arrange a new specified collection.

(iii) Investigation on ecological and meteorological maps of Iran, using basis information sources, regarding the amount of rain, temperature, altitude and the climate of different locations of Iran.

(iv) Accommodating all collected specimens on the above maps and arranging the new maps using this information.

Results and discussion

The locations where the specimens were collected during the travelling and also the places in herbariums were placed on arranged regional maps. First, we transferred all points of collected pistachios on a physical map. Then we accorded these points to other different maps. Using this information, we formed the new maps, which were ecologically based on the pistachios of Iran. The morphology of leaves and the pictures of Iranian pistachio trees in the forests are presented in Figs 1 to 10.

Distribution of pistachios considering altitude

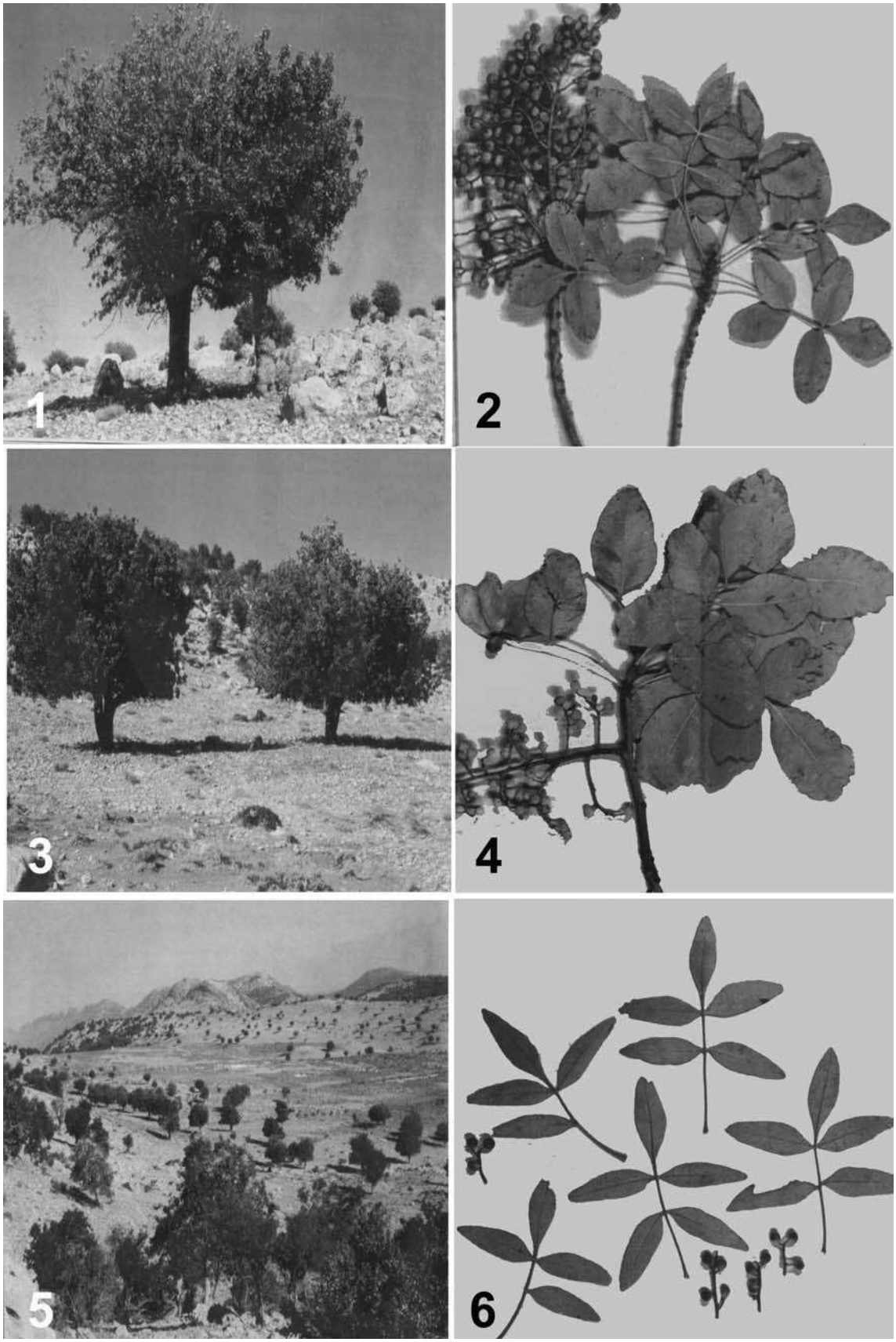
(i) *P. vera* is distributed in altitude of 300-1500 m.

(ii) *P. khinjuk* is spread in places where the altitude is 700-2000 m.

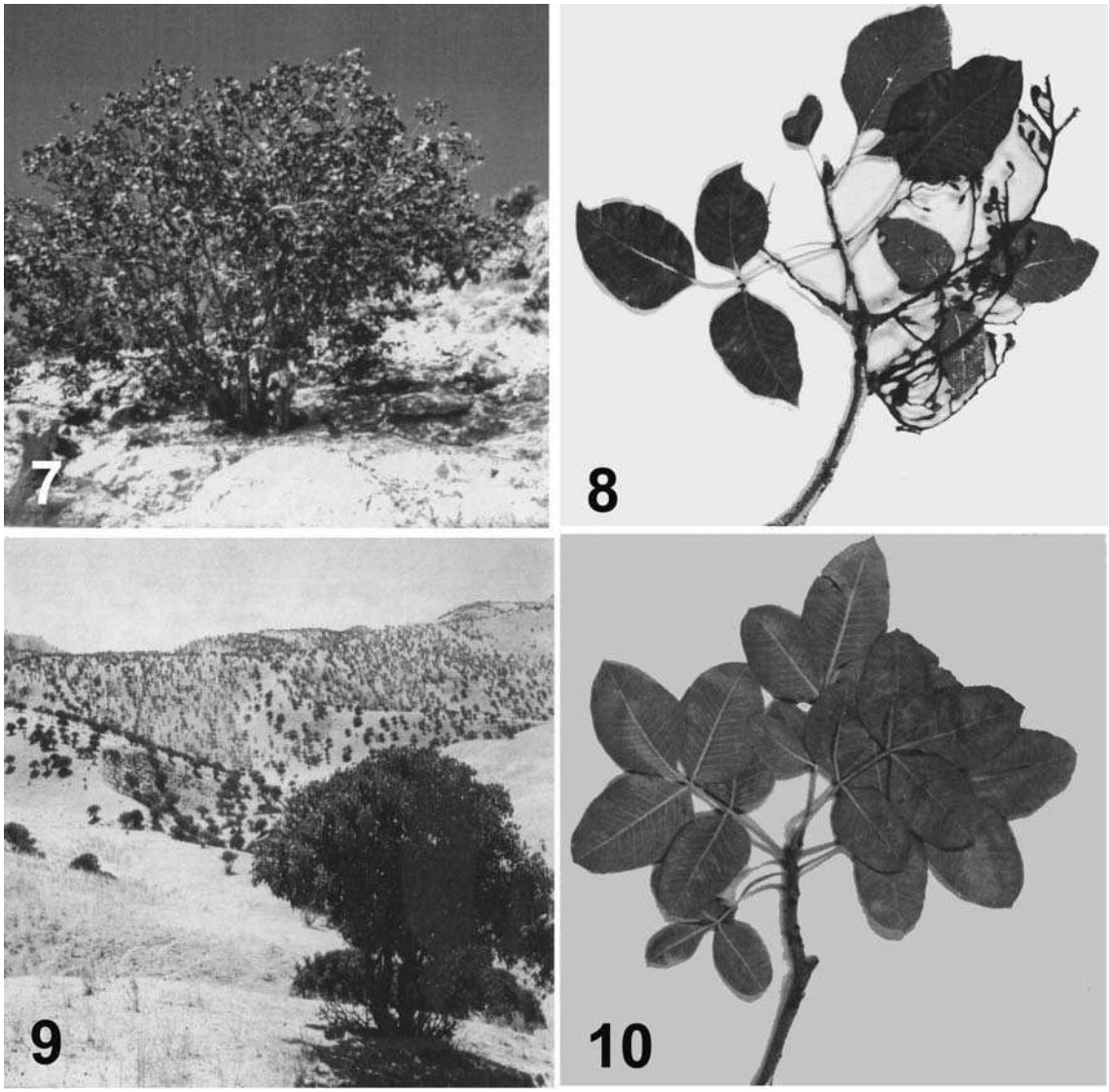
(ii) *P. atlantica* subsp. *mutica* has distributions in regions where the height is 900-2800 m and mostly grows in regions with high altitude.

(iv) *P. atlantica* subsp. *kurdica* is also speeded in places with 900-2800 m of height.

(v) *P. atlantica* subsp. *cabulica* mostly grows in south-eastern regions with height of 50-2500 m. Compared with other species and sub-species, it grows in regions with less altitude (Fig. 11).



Figs 1-6. The morphology of leaves and the pictures of Iranian pistachio trees (Figs 1 and 2: *P. atlantica* subsp. *mutica.* Figs 3 and 4: *P. atlantica* subsp. *kurdica*. Figs 5 and 6: *P. atlantica* subsp. *cabulica*).



Figs 7-10. The morphology of leaves and the pictures of Iranian pistachio trees (Figs 7 and 8: *P. khinjuk*; Figs 9 and 10: *P. vera*).

Distribution of pistachios considering annual amount of rain

Pistacia vera grows only in the north-eastern part of Iran were the annual amount of rain is between 200-300 mm.

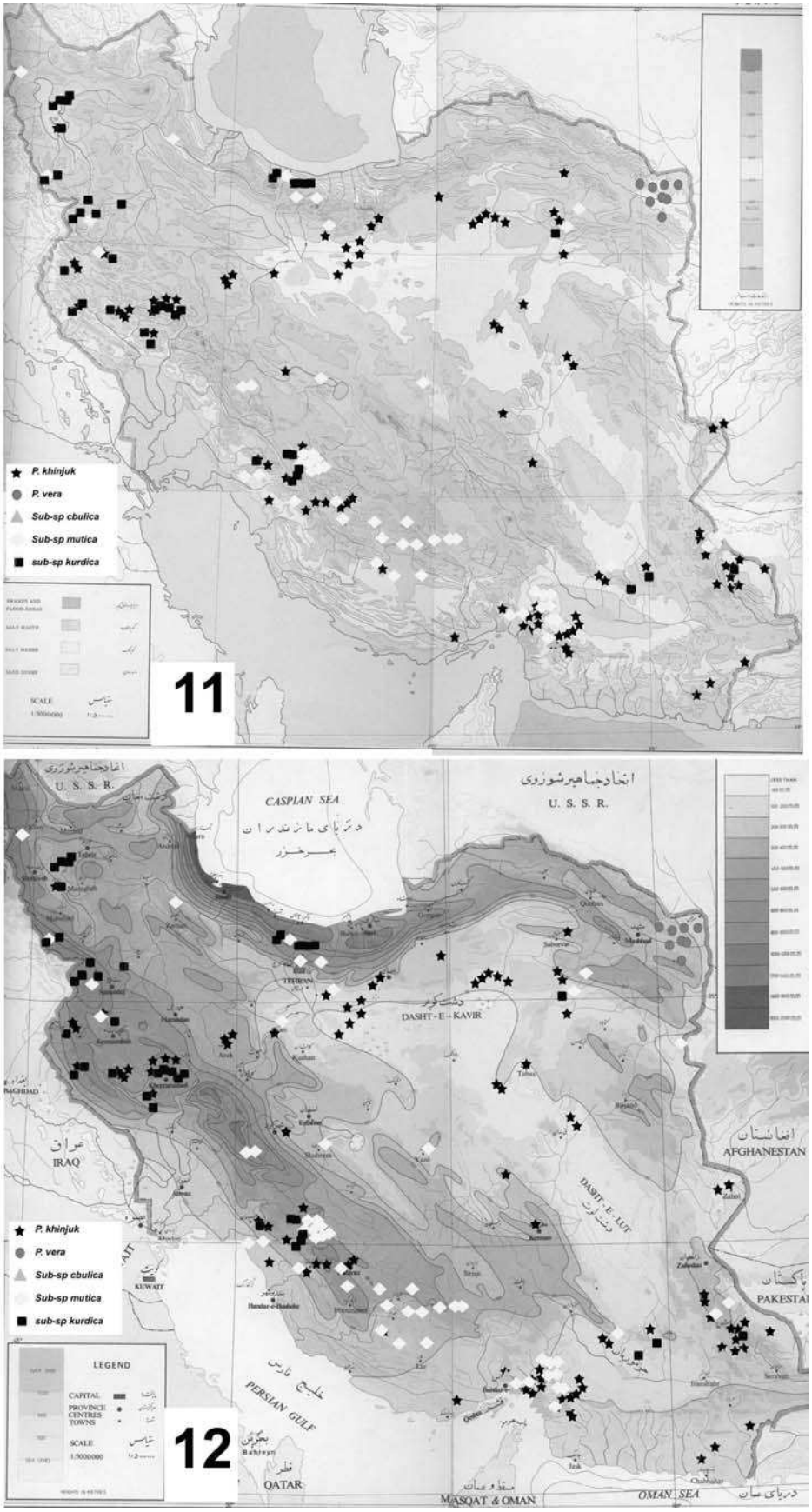
Pistacia khinjuk grows in regions, which have 100-600 mm of rain annually. This specie is less sensitive against droughts and lack of water.

Pistacia atlantica subsp. *mutica* grows in regions that have 200-400 mm of yearly rain.

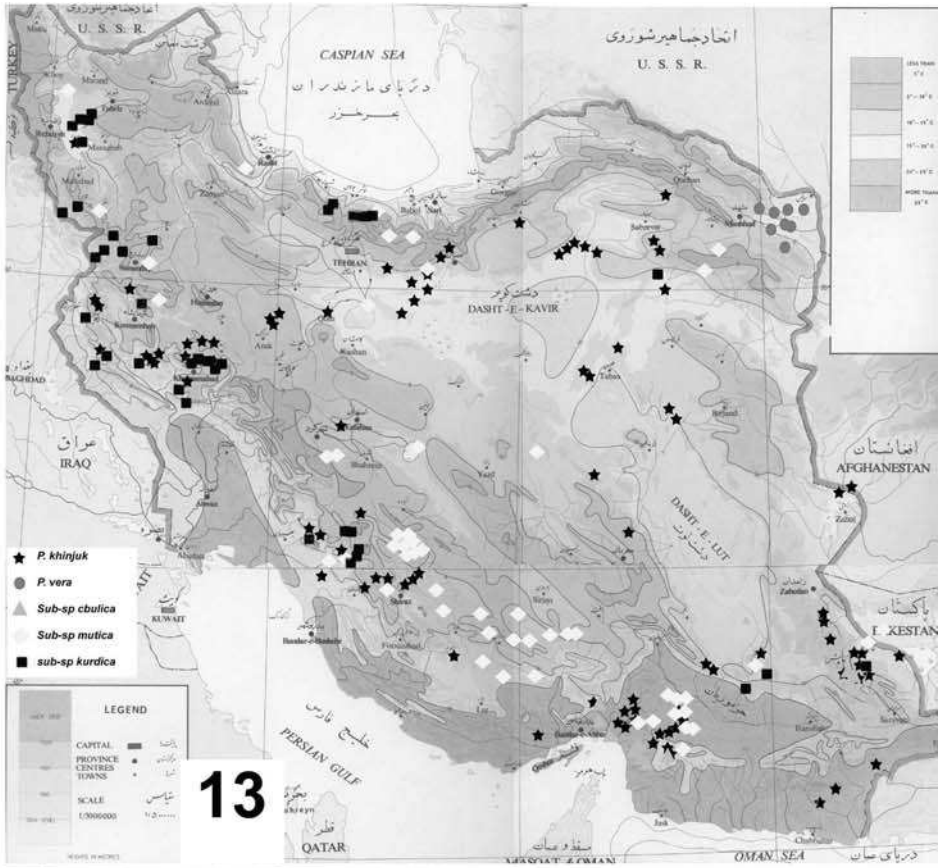
Pistacia atlantica subsp. *kurdica* is distributed in regions with 500-600 mm of rain per year.

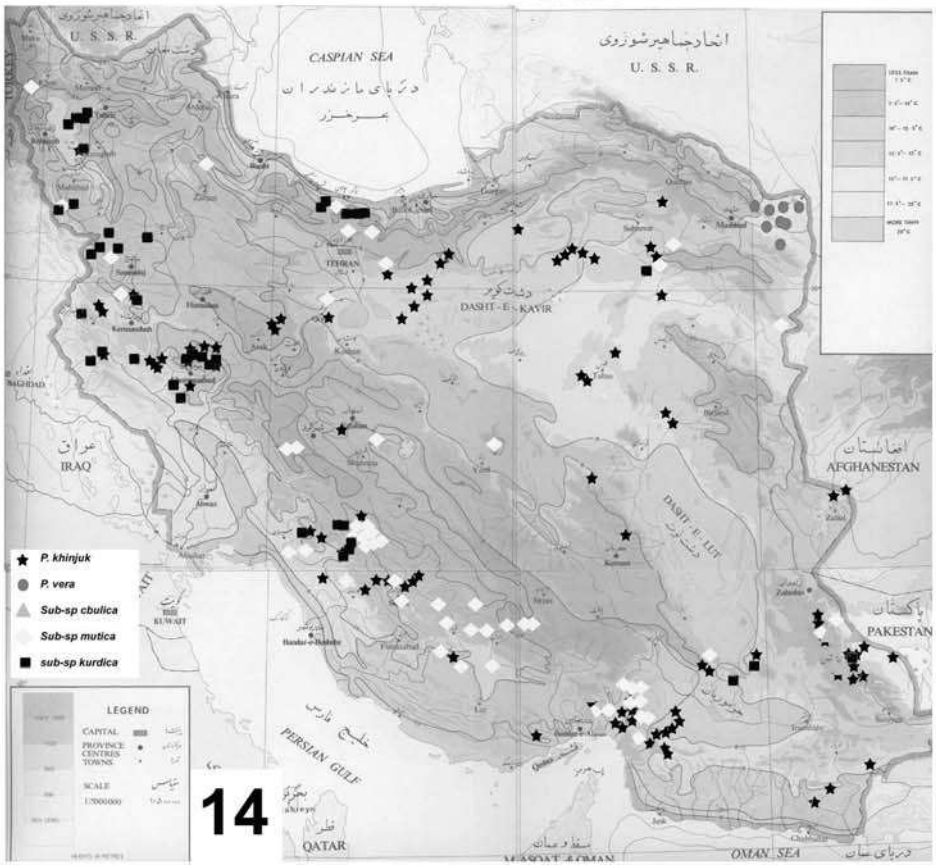
Pistacia atlantica subsp. *cabulica* is distributed in regions which have less than 100 mm rain yearly, and is spread to the regions until 200 mm. This subsp. is the most resistant subsp. of *P. atlantica* to the lack of water.

These results are summarized in Fig. 12.



Figs 11-12. Fig. 11: Distribution of pistachios considering altitude. Fig. 12: Distribution of pistachios considering annual amount of rain.





Figs 13-14. Fig. 13: Distribution of pistachios considering the mean daily temperature. Fig. 14: Distribution of pistachios considering the mean daily range of temperature.

Distribution of pistachios considering the mean daily temperature for the year

(i) *Pistacia vera* grows in regions with an average daily temperature of 10-20°C.

(ii) *Pistacia khinjuk* grows in locations with an annual temperature regime of 10-25°C and it is more widespread than others.

(iii) *Pistacia atlantica* subsp. *mutica* grows in places with an annual temperature regime of 15-20°C. This subsp. is more sensitive to climate compared with the other subsp.

(iv) *Pistacia atlantica* subsp. *kurdica* grows under average temperatures of 5-15°C and it is more resistant to cold than other subsp. and species.

(v) *Pistacia atlantica* subsp. *cabulica* grows under annual temperatures of 15-25°C and it is mainly distributed in the south-eastern parts of the country. It has less sensitivity against heat.

Figure 13 and Fig. 14 orderly illustrate climate distribution of pistachio related to mean daily temperature for the year and the mean daily rang of temperature for the year.

Investigation in these maps show that the distribution of fallowing does not have a distinct limit and in most regions they are mixed together, forming populations of two species or two sub-species. These types of populations are mostly seen in *P. Atlantica* sub-species. Sub-species *cabulica* are more prone to be apart from the others. *P. vera* grows in a completely separate region, namely Sarakhs. *P. khinjuk* is able to distribute in all regions and it is seen with or without the other species. These researches show that *P. khinjuk* has less sensitivity against heat, height, and amount of rain, dryness and other hard conditions of the regions. In conclusion, we can conclude *P. khinjuk* is the best species in order to be cultivated in different climates and regions. Therefore *P. khinjuk* is advised as the best species to be used as rootstocks in plan form or in hybrid. Providing aerial survey maps in future can give better and more exact results towards other researches.

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