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ORIGINAL PAPER

Effect of physiographic factors on qualitative and quantitative characteristics of *Cornus mas* L. natural stands in Arasbaran forests, Iran

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Abstract: Arasbaran forests are located in East Azerbaijan (northwest Iran). Increasing of socio-economic problems in this area causes destruction of biodiversity and structure of these forests. Using multipurpose trees such as cornelian cherry (*Cornus mas L*) to encourage villagers to produce forest by-products is a basic approach for preserving these forests. This species grows naturally in Arasbaran forests and the fruit is annually exploited using traditional harvest methods. This study aims to assess the ecological requirements of cornelian cherry and the important factors affecting its distribution. For this purpose, 40 circular sampling plots (300 m^2) on various slope aspects were demarcated for sampling the occurrence of cornelian cherry in forest stands. DBH and crown cover percentage on north aspects were significantly greater than on other aspects and 4.5% of all trees were cornelian cherry in mature forest stands. North aspects had more seed-origin trees (standards) of cornelian cherry than coppiced trees, while west facing aspects had more coppiced than standard trees. This species had the highest regeneration rate in the sapling stage of 0–2.5 cm DBH. Thus, I recommend cultivation and development of cornelian cherry as a multi-purpose tree in the Arasbaran region on degraded forest lands on north and west aspects.

Keywords: Arasbaran forests; aspect; physiographical factors; cornelian cherry (*Cornus mas* L.)

Introduction

Iran's forests cover over 14.2×10^6 ha and are divided into two general categories: northern forest (Hyrcanian) and northern outside forests (Keikhosravi & Kouchpideh 2007) which together cover about 8.6% of the nation's land area. Northern outside forests are not harvested for wood production, but play a valuable role in the national economy in terms of local livelihoods and environmental conservation, especially in soil and water resource conservation (Anonymous 2008). Arasbaran forests which are known as a northern outside forest are located in East Azerbaijan Province in northwest Iran. Diversity of microclimates and physiographic conditions result in a range of plant community types and rich biodiversity, making the site quite different from other forest zones throughout the country (Alijanpour 1996). Birang et al. (1993) reported 1,334 plant species of 493 genera and 97 families in the Arasbaran region. Degradation of these forests is caused mainly by inhabitants of the forest and adjacent villages. One strategy for conservation and renovation of Arasbaran forests is to encourage participation of these people in agroforestry and production of by-products from multi-purpose trees (Shamekhi 2006). One of these species is cornelian cherry which is considered an economically important species in Arasbaran forests. This species is propagated in Europe, Caucasus and Anatolia (excepting the north Mediterranean and Atlantic areas) (Mozafarian 2004). Villagers preserve cornelian cherry in natural stands to create fruit gardens (Sabeti 1994). The average annual fruit harvest is 914 kg per hectare in Kalaleh village in Arasbaran region (Ghanbary 2009). Cornelian cherry as a native species of the European continent that is resistant to biotic and abiotic factors. It grows best at elevations around 1,400 m. This species is able to grow at low temperatures (to -40 ºC) and its longevity is about 300 years (Brindza et al. 2007). Demir et al. (2003) mentioned cornelian cherry as a multipurpose species useful for production of fresh fruit that can be dried and preserved as jam or jelly. The bark and timber are also useful, and the leaves are a good source of tannin. Because of its high density wood, it has been used to produce some special tools and equipment. The mean weight of the fruit was about 2.8–3.85 g in Turkey in north Anatolia (karadeniz et al. 2009) and 2.11 to 6.71 g among 18 cornelian cherry genotypes in Vojvodina Province, Serbia (Bijelic´et al. 2011). Turkey has a long history of cultivating this species and there are 1.2×10^6 cornelian cherry trees in Turkey (Ercisli et al. 2008) where 12,800 tons

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of fruit are harvested annually (Tural & Koca 2008). Each shrub produces between 2.8 and 4.8 kg of fruit annually. Cornelian cherries are very valuable for their medicinal and nutritional benefits and for production of raw materials for cosmetics. Vitamin C content in cornelian cherries is twice that of oranges (Klimenko 2004). In Serbia, Bijelic´et al. (2011) reported chemical composition of the fruit mesocarp including content of total dry matter (TSC), soluble solid content (SSC), total acids, total and reducing sugars, sucrose, Capectates, vitamin C, proteins, cellulose, anthocyanins, and tannins at 18%–33%, 17%–32%, 2%–4%, 12%–26%, 10%–24%, 0.4%–3%, 0.3%–2%, 15%–39 mg per 100 g fruit, 0.2%–3%, 0.4%–1%, 36–127 mg per 100-g fruit, and 0.6%–1.5%, respectively. Our research objective was to describe qualitative and quantitative characteristics of cornelian cherry in natural forest stands with respect to physiographic attributes such as aspect and slope.

Materials and methods

Study area

Arasbaran area comprises Ahar and Kaleybar cities. The study area is located in the Arasbaran forests, which consist of part of Garmnab, Harehsar, Armeni Olen, Ainalou and Vayeghan forest units. The total area is 708.6 ha. According to 15 years of statistic data of Kaleybar meteorology station, annual rainfall ranges from 289.5–521 mm with annual mean rainfall of 405.1 mm. Mean annual temperature is 17ºC at low elevations and 5 ºC in the high mountains. This area is related to the third period of geological age and the main rock types are calcareous and volcanic. The soil in forest areas is mainly brown and calcareous forest soil (Alijanpour 2001).

The main woody species in Arasbaran forests are Hornbeam (*Carpinus betulus*), Oak (*Quercus petrea*), Maple (*Acer campester*), Wild cherry (*Cerasus avium*), Yew (*Taxus baccata*), Ash (Fraxinus excelsior) and cornelian cherry (Marvie mohadjer 2005). Different forms of forests, including dense forest, semi-dense forest, shrubland and bushland are distinguishable in this area (Alijanpour 2001; Alijanpour et al. 2004).

Data collection

To evaluate quantitative and qualitative characteristics of cornelian cherry, we demarcated sampling plots in the forest stand at cardinal points where this species was most numerous within mature and regenerating stands. Considering the number, form and area of sample plots used in previous studies (Alijanpour et al. 2003) and estimated costs (Zobeiri 2005), authors sampled 40 circular plots, each of 300 m^2 area. The plots were set on four main slope aspects (10 sample plots in each main aspect). At each sample plot, the general specifications were noted. Then, the mature stand was assessed and all trees with >7.5 cm diameter at breast height (DBH) were measured and their origin and quality were recorded. For studying regeneration, they were divided into seedling, sapling and thicket initially and then individuals were counted. Thicket groups were classified into three groups: at DBH categories of 0–2.5 cm, 2.5–5 cm and 5–7.5 cm. In each plot, a soil sample from depth of 0–30 cm was collected and analyzed in Urmia University lab. In each plot I recorded tree/shrub species, percentage of crown cover, forest floor vegetation percentage, aspect and slope were coded and the data were prepared using Excel software. We used chi-squared test for comparing frequencies. ANOVA and Dunkan tests were applied to analyze and compare contiguous data. All statistical analyses were done using SPSS 15.

DCA (Detrended Correspondence Analysis) was applied to quantify relationships between distribution of species in the *Cornus mas* sites and environmental variables. Before data analysis, rare species were deleted from the species matrix. Cover data were transformed using ordinal transformation (van der Maarel 1979).

Aspect data were transformed using the equation A'=cos (45-A) +1 (Beers et al. 1966). The matrix of soil physical and chemical variables and physiographical features was standardized to mean 0 and variance 1 for each variable prior to ordination. The computer program PC-ORD for Windows version 3.0 (McCune and Mefford 2002) was used for this analysis.

Results

Mean DBH, crown coverage percentage, and seed-origin tree (standard tree) percentage on north aspects were significantly greater than on other aspects, while forest floor vegetation percentage was greater on south and east aspects (Table 1). There was no significant difference between percentages of healthy trees on different aspects (at 5% level), whereas there were significant differences in other cases (Table 1). Species mixture percentage is an important factor determining structure, type of forest stand and dominant species. Hornbeam (53.1%) and Wild cherry and wild apple (each 0.3%) were maximum and minimum of mature stand combination percentage, respectively (Fig. 1). Cornelian cherry accounted for about 4.5% of the trees in mature stands, so this species was not generally cultivated as the main and dominant species.

Table 1. Stand characteristics of cornelian cherry forest by cardinal point

Site aspect	Average of DBH (cm)	Percentage of crown coverage (%)	Percentage of forest floor vegetation (%)	Percentage of seed-origin tree (%)	Percentage of healthy (%)
North	14.92^{a}(0.43)	81.69^{a}(0.48)	9.68^{d}(0.85)	55.2^{a}	90.9
East	12.1^{c}(0.87)	68.19^{c}(1.65)	22.5^{a}(2.12)	26.7^{b}	100
South	13.17^{bc}(0.52)	56.25^{d}(1.68)	30.49^{a}(2.25)	14^{c}	100
West	13^{bc}(0.90)	74.42^{b}(0.82)	14.88^{c}(0.68)	43.2^{a}	91.9

Notes: Numbers in parenthesis are standard deviations. Different letters denote significant differences between aspects.

Diversity of woody plants on north and west aspects was greater than on south and east aspects, and cornelian cherry trees