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Original Article

Study of some Ecological Characteristics and Potential Allelopathic of *Otostegia persica* in Hormozgan Province

Aghir Khalil Aria[1], Mohammad Amin Soltanipoor[2*] and Rahman Asadpour[3]

[1*]*Bandar Abbas Branch, Islamic Azad University, Bandar Abbas, Iran*
[2,3]*Hormozgan Research Center for Agriculture and Natural Resources, Bandar Abbas, Iran*

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Abstract

Otostegia persica (Burm.) Boiss. is the medicinal plant of Lamiaceae family that has long been used traditionally in treatment of severe diarrhea, common cold, flatulence, headache, sore, fever, skin allergies, and blood fat and sugar. This research was conducted in 2013 for one year to identify some ecological characteristics and potential allelopathic of *O. persica* in Hormozgan province. The climate, geology, geo-morphology, land types, associated species, distribution map, growth parameters, soil physical and chemical properties, and the phenology were studied in five regions, including Abmah, Bokhon, Geno, Tangezagh and Bashagard. Also, effects of aqueous extract prepared from leaves of *O. persica* on 6 species of *Brassica oleracea* L., *Raphanus sativus* L., *Lepidium sativum* L., *Coriandrum sativum* L., *Zinnia elegans* L. and *Calendula arvensis* M. Bieb. were studied. This species is distributed in an altitude of 250-1850 m a.s.l, from the northernmost point of the province to the closest region to the Persian Gulf and from the westernmost point to Bashagerd in the east province. The climate of the study area is arid and hot desert. More than 57.6% of the habitats is mountainous of which 54.6% has limestone formations. The soil texture is sandy loam with pH and EC ranging from 7.42-8.36 and 0.97-1.52, respectively. Aqueous extract prepared from leaves of *O. persica* inhibited seed germination and decreased speed germination and seedling growth.

Keywords: Ecology, Potential allelopathic**,** *Otostegia persica*, Hormozgan province

Introduction

Otostegia persica (Burm.) Boiss. is one of the most important and most frequently used medicinal plants in Hormozgan province. It has been long used to treat various diseases. This is a high-selling species in Hormozgan markets and groceries, and traditionally is exported to the Persian Gulf countries. Given the widespread use of this species and its important role in the economy of rural households and traditional exports, leading to excessive harvesting, steps need be taken for the cultivation and domestication of this species. For this purpose, initially, ecological requirements of the studied species need be taken into consideration.

O. persica, belonging to the Lamiaceae family, is a perennial shrub with multiple branches, prickly and covered with short coarse trichomes, reaching to a height of 1-1.5 m [1, Fig. 1].

This species has long been used traditionally in treatment of hypertension, bone pain, constipation, fever, headache, itchy throat, stomachache and adjusting menstruation in different forms including boiled, crushed and softened leaves, incense, and decoction of leaves and flowers [2].

In terms of geographical distribution, this plant is distributed exclusively in Pakistan and Iran [3].

In Iran, it grows naturally in Irano-Tourani and Khalij-Omani regions including Yazd, Fars, Booshehr, Kerman, Balouchestan, and Hormozgan provinces [1].

[*]Corresponding author: Hormozgan Research Center for Agriculture and Natural Resources, Bandar Abbas, Iran
Email Address: masoltanipoor@yahoo.com

Fig. 1 The medicinal plant of *Otostegia persica* (Burm.) Boiss.

Three compounds identified in this species (morin, kaempferol and quercetin) have antioxidant activity [4]. This plant contains flavonoids including quercetin and morin which are effective in reducing blood sugar [5].

Material and Methods

In this study, the plant samples were collected from different regions of species distribution and were transferred to the herbarium for identification. Then, the species distribution map was prepared. To determine the growth parameters of the studied species and their relationship with ecological factors, five regions were selected as follows: Abmah, Bokhon, Geno, Tangezagh and Bashagard (Table 1). In each region, 20 transcets of 50-m length were established. Sampling points were considered along the transects at 10-meter intervals and the distance from the nearest species to these points was measured. Growth parameters including height, canopy cover percentage, canopy cover area and density were calculated. Soil and phenology studies were also conducted in these five regions. Soil samples were taken from 0-30 cm soil depth and soil texture, EC, pH, anions, and cations including carbonate, bicarbonate, chloride, calcium and magnesium were measured. Phenological stages were recorded every week. Information of geology, geomorphology,
land types, and climate were prepared using the existing maps. For study on potential allelopathic of *O. Persica*, effects of aqueous extract prepared from leaves of *O. persica* on 6 species of *Brassica oleracea*, *Raphanus sativus*, *Lepidium sativum*, *Coriandrum sativum*, *Zinnia elegans* and *Calendula arvensis* were studied.The laves of *O. persica* were collected from Geno and seeds of plants were obtained from Research Center for Agriculture and Natural Resources Hormozgan. For preparing aqueous extracts of the leaves of *O. persica* 50 grams of powdered leaves were dissolved in 100 ml distilled water and then at laboratory temperature for 24 hours the mixture was stirred by a magnetic stirrer. Homogenates solution obtained after flattening twice by two layers of Tiffany at 4500 rpm for 20 minutes was centrifuged. Supernatants as aqueous extract (stock) were used in the experiment. After disinfection hundred seeds equidistant from each other about the same shape and size and placed in glass petri 5 ml of the extract was added to each dish. Daily count after 15 days of germination percentage, speed germination and root growth and shoot measurement and control (distilled water) were compared. Completely randomized design with three replications for each treatment were considered. The mean values were based on t test.

Results and Discussion

Tables 2 and 3 shows that aqueous extract prepared from leaves of *O. persica* inhibited seed germination and decreased speed germination and seedling growth. In the *Brassica oleracea*, Seed germination rate was reduced to zero. Statistically, In percentage of seed germination, there were more significant differences between aqueous extract and control in *Lepidium sativum*, *Brassica oleracea*, *Coriandrum sativum*, *Zinnia elegans* and *Calendula arvensis and* significant differences in *Raphanus sativus.* In speed of seed germination, there were more significant differences between aqueous extract and control in all of plants.

Table 1 Some of environmental factors of *Otostegia persica* (Burm.) Boiss.habitates.

Parameters	Regions				
	Abmah	Bokhon	Geno	Tangezagh	Bashagard
Climate	Arid and hot desert	Arid and hot desert	Arid and hot desert	Arid and moderate desert	Arid
Temp. (°C)	22.5	25	22.5-25	20	26.5
Evapor. (mm)	2800-3000	3200-3400	3400-3600	2800-3000	3200-3400
Geology	Bakhtiary coglumerate	Miocene limestone	Miocene limestone	Miocene limestone	Miocene limestone
Land type	2.3	1.6	1.1	1.3	2.3

Table 2 Mean comparison with t-test method.

Plants	seed germination	speed germination	radicle growth	plumule growth
Zinnia elegans	34.3^{**}	21.76^{**}	16.71^{**}	24.42^{**}
Raphanus sativus	4.34^{*}	11.83^{**}	7.92^{*}	5.91^{*}
Calendula arvensis	72.39^{**}	86.3^{**}	18.14^{**}	14.81^{**}
Brassica oleracea	45.29^{**}	12.71^{**}	44.78^{**}	52.59^{**}
Lepidium sativum	18.82^{**}	33.21^{**}	5.11^{*}	9.59^{*}
Coriandrum sativum	10.124^{**}	28.57^{**}	8.05^{*}	11.25^{**}

Table 3 The average of the six measured traits seeds.

Plants	Treat.	seed germination	speed germination	radicle growth	plumule growth
Zinnia elegans	Control	84	12.2	3.3	4.3
	Aqueous	29.3	3.7	1.13	2.63
Raphanus sativus	Control	100	24	2.6	3.1
	Aqueous	90	15.03	1.53	2.23
Calendula arvensis	Control	80	10.1	3.5	4.2
	Aqueous	21	1.5	2.23	3
Brassica oleracea	Control	26	2.2	2.56	3.05
	Aqueous	0	0	0	0
Lepidium sativum	Control	84	12.2	1.7	2.3
	Aqueous	29.3	3.07	0.56	1.13
Coriandrum sativum	Control	53	5.9	1.9	2.9
	Aqueous	36.7	3.9	1.03	2

Table 4 Some of vegetative factors of *Otostegia persica* (Burm.) Boiss.

Parameters	Regions				
	Abmah	Bokhon	Geno	Tangezagh	Bashagard
Distance ave. (m)	2.2a	1.85a	2.4a	1.9a	1.83a
Height ave. (cm)	124ab	144a	148a	165a	88b
Long Diameter ave. (cm)	132b	152b	170a	131b	102.6c
Small Diameter ave. (cm)	126b	119b	163a	129b	76.5c
Mean Diameter ave. (cm)	134b	135b	166a	132.5b	89.55c
density (in hectare)	516.53	730.46	434.03	692	738
Canopy cover ave. (m^2)	1.41	1.44	2.16	1.32	0.63
Canopy cover ave. (m^2. hectare)	728.07	1059.79	637.5	913.4	464.9
Canopy cover percentage (hectare)	7.28	10.52	6.37	9.13	4.7

Means with the same letter are not significant. Height average in α=0.05 level and the rest in α=0.01 level were significant.

Table 5 Physical and chemical characteristics of soil of *Otostegia persica* (Burm.) Boiss.

Regions	Texture	Sand (%)	Silt (%)	Clay (%)	pH	EC	N. M. (%)	O.C.%
Abmah	Sandy loam	52	32	16	7.43	1.52	54.50	0.273
Bokhon	Sandy loam	68	22	12	7.87	1.01	48	0.621
Geno	Sandy loam	57.6	32	10.4	8.36	0.97	52.53	0.248
Tangezagh	Sandy loam	65.6	26	8.4	8.30	1.10	50.83	0.286
Bashagard	Sandy loam	59	33	8	7.42	1.10	29.32	0.293

Table 5 Continue of

Regions	Gypse	K+ absor.	Na+	Mg^{+2}	Ca^{+2}	CO_3^{-2}	HCO_3^{-1}	Cl^-
Abmah	0	220.8	3.2	4.8	7.6	0	1.8	3
Bokhon	0	166	2.25	1	7	0	3	3
Geno	0	28	3	4.7	3	0	0.24	2
Tangezagh	0	21	1.7	4.8	4	0	0.75	2.1
Bashagard	0	225	2.6	2	8.6	0	1.9	2.5

In radicle growth, there were more significant differences between aqueous extract and control in *Brassica oleracea*, *Raphanus sativus*, *Zinnia elegans* and *Calendula arvensis* and significant differences in *Lepidium sativum* and *Coriandrum sativum*. In plumule growth, there were more significant differences between aqueous extract and control in *Brassica oleracea*, *Zinnia elegans*, *Coriandrum sativum* and *Calendula arvensis* and significant differences in *Lepidium sativum* and *Raphanus sativus*.

O. persica is distributed in 33 locations of the province and Abmah, Bokhon, Geno, Tangezagh and Bashagard are the major ones. Climate, average temperature, average annual evaporation, geological and land type characteristics, are presented in Table 1. Soil and vegetative characteristics are shown in Table 4 and Table 5, respectively.

The species is observed in the following vegetation types:

Cousinia stocksii C. Winkl.+*Gymnocarpos decander* Forssk. , *Artemisia sieberi* Besser+ *Ebenus stellata* Boiss., *Convolvulus spinosus* Burm. F.+*Gymnocarpos decander* Forssk., *Convolvulus spinosus* Burm. F.+*Ebenus stellata* Boiss., *Convolvulus spinosus* Burm. F.+ *Cousinia stocksii* C. Winkl., *Rock+Amygdalus scoparia* Spach.

Around 154 species are observed in the habitats of *O. persica* of which 17 species are common in all habitats as follows: *Amygdalus lycioides* Spach, *A. scoparia, Astragalus fasciculifolius* sensu C.C.Towns., *C. spinosus, Cymbopogon olivieri* (Boiss.) Bor, *Dodonaea viscosa* (L.) Jacq., *Ebenus stellata* Boiss., *G. decander, O. persica, Periploca aphylla* Decne, *Pistacia atlantica* Desf., *Pistacia khinjuk* Stocks, *Platychaete aucheri* (Boiss.) Boisss., *Stachys inflata* Benth., *Teucrium polium* L., *Teucrium Stocksianum* Boiss.

Vegetative growth stage of *O. persica* starts from mid january. With increasing altitude, the vegetative growth stage is delayed so that in the highlands it starts from mid-March. Flowering begins from the third week of March and in early April the peak of flowering will occur. Seeding stage starts from late April, and from the third week of May seeds are fully mature. Seed shattering stage starts from late May and continues to mid June, and with the onset of hot weather, plant dormancy period begins and continues until February.

The highest distribution of *O. persica* in Hormozgan province is related to mountain land type with Bakhtiary coglumerate and Miocene limestone formations whose soil texture is sandy loam (Table 1).

This species is distributed from an altitude of 50 m a.s.l in Parsian region to 2400 m a.s.l in Fareghan region.

The species height varies from 88 to 165 cm, so that the highest height recorded for trangezagh region showed significant difference with other regions (Table 4).

The average large and small diameters are 163.3-170*76.5-102.6 and the species density varies between 434-738 per hectare (Table 4).

Higher species density in Bashagard and Bokhon, compared to other regions, may be due to less exploitation in these regions (Table 4).

The calcareous formations in the area cause increasing moisture retention. The development of species canopy cover in Geno region is also due to less competition between species.

The temperature in the coastal areas does not reach zero and the the mean annual relative humidity in coastal area varies from 56.2 to 69.8 percent.

However, in the northern areas of the province, in Haji Abad, the temperature is below zero (-3 °C) and the the percentage of relative humidity in the northern areas of the province is much lower than that of the coastal areas.

It is nothworthy to state that the distribution of this species is limited by increasing the latitude and decreasing temperature in neighboring provinces, so that it is not observed in the provinces of Kohkilooye Boyerahmad, North Fars, northern and western parts of Kerman and sistan.

Overall, it can be stated that since this species is distributed in the northern, western and eastern parts of the province, it seems that climate factors are not important factors, affecting the distribution of this species in Hormozgan province.

Therefore, the main factor in distribution of this species in Hormozgan province should be sought in soil characteristics.

It is noteworthy that the soil in all habitats of this species was free from gypsum. The soil texture in all study areas was sandy loam (Table 5).

As stated above, soil characteristics and the growth bed of this species are the factors limiting the distribution of this species in Hormozgan province so that it is not found in alkaline, saline and alkali-saline soils. Soil texture is another factor limiting the growth of species so that heavy-textured soils limit the distribution of this species; in adiition, this species is not found in light-textured soils and in terms of soil texture it demands a medium-to- light textured soil.

This species is seen in mountainous lowlands, hills, upper terraces, gravelly colluvial soils, and plains.

According to Hosseini (1998) [6], soil, ground water and rainfall were identified as the factors affecting the distribution and establishment of *Puccinellia distans* (Jacq.) Parl.. Najafi (1999) [7] reported that climate factors were not important limiting factors in the distribution and abundance of *Zygophyllum atriplicoides* Fisch. & C.A. Mey., because this species grows well in diffrenet geographical aspects as well as the plains and slopes and in light-textured soils low in organic matter.

Our findings were not in accordance with the results of Najafi (1999) [7] and Asadpour and Soltanipoor (2009) [8] who reported that climate factors were not important limiting factors in the distribution and abundance of *Z. atriplicoides*, and *C. olivieri*, respectively. Our results correspond to the findinings of Hosseini (1998) [6] who reported on the establishment limitation of this species with soil factors. Naseri and Jalily (1998) [9] reported salinity as a limiting factor for the growth of *Atriplex canescens* (Pursh) Nutt., confirming our results for the distribution of *O. persica*.

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