INNSPUB

Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 9, No. 1, p. 297-303, 2015
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

# Evaluation of some ecological factors, physiological and morphological traits of *Salvia tebesana* Bunge

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Article published on July 30, 2016

**Key words:** *Salvia tebesana* Bunge., Ecological factor, Physiology, Morphology, Endemic.

**Abstract**

Study on relationships between a species with its surrounding biotic and abiotic environment provides valuable information in terms of optimum choice for utilization, propagation, breeding and domestication. For this purpose several ecological and morphological points of *Salvia tebesana* was studied in Tabass, where the only habitat of the plant is. It is more important that *S. tebesana* is one of the 17 endemic species of genus *Salvia* in Iran. The climatology of the study area was determined by statistic 10-year-old. Chemical and physical analyses of the soil were measured in 5 replications according to standard methods. For ecologic analysis, plant samples were considered in different stages such as vegetative, flowering and seeding period. Plant nutrient in three main phases' growth (vegetative growth, flowering and seeding), phenology, co-dominant plant and morphological features were determined, too. Results revealed that *S. tebesana* is distributed in region with pH=7.12-7.97, Ec=0.96-1.21 ds/m, TNV= 28.8-46% and sandy-loam texture. According to 10-year statistics, the average rate of rainfall in this habitat is 123.1 millimeters and average annual temperature is 17.7 centigrade. This plant grows as a shrub with the height of 16-24 centimeters. Vegetative growth begins in March, flowering stage occurs in May and seeding happens at mid June. According to the outcome, domestication and breeding program are urgently required for the conservation of this valuable but endangered species.

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## Introduction

The genus Salvia with over 900 species is probably the largest member of the family Lamiaceae and is found in both subtropical and temperate parts of the world (Walker and Sytsma, 2007).

In the flora of Iran, the genus is represented by about 58 species of which 17 are endemic. The name Salvia comes from the Latin word Salvare, which means healer. (Rechinger, 1982; Hedge *et al.,* 1986; Mozaffarian, 1996; Chalchat *et al.,* 1998; Naser moadeli *et al.,* 2013). Many Salvia species (Sage plants) are used in different countries (Ulubelen *et al.,* 1997; Demirci *et al.,* 2002) as herbal tea and flavoring agent as well as in cosmetics, perfumery and the pharmaceutical industries (Chalchat *et al.,* 1998).

It is received that potential therapeutic activities of the genus are due to their essential oils (Leung and Foster, 1996). Recently, interest in the ecology of plants has increased (Abdel-Ghani *et al.*, 2011).

It seems to be important because of relationships between a species with its surrounding biotic and abiotic environment provides valuable information in terms of optimum choice for utilization, propagation, breeding and domestication. In other words by knowing and understanding the ecological requirements of such native plant species, they can be used for improving desertified rangelands (Azarnivand Dsamalchi, 1998).

Many studies have done about the autecological characteristics of various range plants species throughout the world. It could be cited that *Salsola orientalis* S.G.Gmel. can be used for the rehabilitation of rangelands in poor ecological conditions in the central steppes of Iran (Saeefar *et al.*, 2006).

A study found a relationship between the distribution pattern of *Salvia rosifolia* Sm. and the concentrations of N, P, and K in soil (Kaya and Aksakal, 2007). Another study on *Stipa barbata* Desf. showed that the loamy-sandy and clay-loamy soils with pH of 8.1 to 8.7 are principal soils in its habitats at semi-arid rangelands of Tehran Province, Iran (Farahani *et al.*, 2008).

An investigation about ecological significance of *Campanula romanica* Savul. in Romania and ecological character of the medicinal plant *Tilia rubra* Dc. in Turkey was done (Bayrak Özbucak and Ergen Akçin, 2013; Gostin and Oprea, 2013). Finally a research probed into the morphology, anatomy and ecology of *Ophrys lutea* Cav. in Turkey (Durmuskahya *et al.*, 2014).

As can be seen there are many researches on dissimilar plants but no study has reported the ecological requirements of *Salvia tebesana* Bunge. to date. The objective of this study was to investigate some ecological, physiological and morphological characteristics of the plant that is done for the first time to reveal its ecological requirements which is under the danger of extinction.

## Materials and methods

*The selective site*

The study area is located near Tabasss, (South Khorasan, Iran) where the only habitat of the plant is. Based on a 10-year-old report made by climatically bureau, the average annual precipitation and temperature, mean maximum and minimum temperatures was determined. The climate discovered on the basis of De martenne and Ambrgeh.

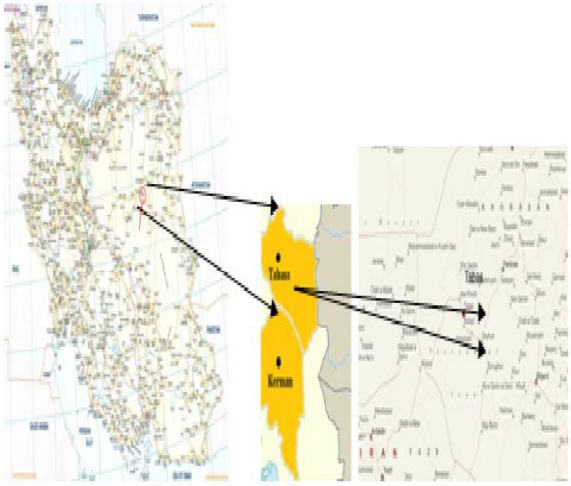



**Fig. 1.** The study area.

*Soil parameters*

Samples were performed with 5 replications from 0-50 cm depth where the distribution of root growth is. The samples were passed through a 2 mm sieve and subjected to analysis.

The chemical analyses of the soil samples were about nitrogen, phosphorus, potassium and its physical properties such as pH, TNV, electrical conductivity, organic carbon and soil texture were measured according to Kjeldahl, Spectrophotometer, Flam photometer, pH meter, Titration, Conductivity meter, Titration and Hydrometric methods, respectively.

*Plant parameters*

Finding the plant was compared with herbarium specimens to be approved. For ecologic analysis, plant samples were considered from the locality in different stages such as vegetative, flowering and seeding period. In following, plant nutrient, phenology, and co-dominant plant were determined.

To study and evaluate quantitative morphological characters, 20 morphological features of *S. tebesana* were examined that was collected from proximity at flowering and seeding stage. It seems to be important that to determine the nutrient plant sampled in three main phases growth (vegetative growth, flowering and seeding). Preparing the samples phosphorus (Spectrophotometer), potassium (Flam photometer), nitrogen and protein (Kjeldahl) were analyzed. Selective specimens were similar in terms of age, freshness, soil and canopy cover.

**Result**

*Brief climatology of the study area*

According to 10-year statistics, mean annual temperature and precipitation is 17.7°C and 123.1 mm, respectively. It is important that the major rainfall is in the winter. The rainfall regime in this area, as in most parts of the Mediterranean diet, which is the major rainfall, occurs in the cold season. Mean maximum and minimum 24.1 and 11.2 ° C in this period, respectively. Statistics show the climate based on De martenne and Ambrgeh method is arid and semi-arid.

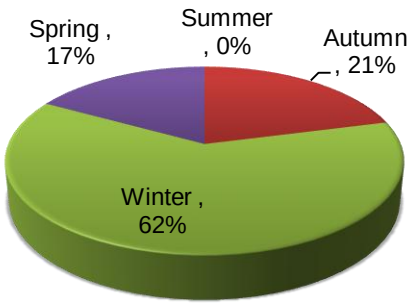



**Fig. 2.** Mean annual precipitation.

*Soil results*

The results can be seen in Table 1. The assessment of soil in the studied area showed that pH=7.12-7.97, Ec=0.96-1.21 ds/m, TNV= 28.8-46% and the soil texture is sandy-loam. The mean of nitrogen, phosphorus and potassium was 105.37, 3.78 and 238.46, respectively.

**Table 1.** Analysis results of the soil samples.

| Station | Ec dc/m | pH | TNV % | OC% | N (ppm) | P (ppm) | K (ppm) | Texture |
|---|---|---|---|---|---|---|---|---|
| 1 | 1.20 | 7.87 | 33.6 | 0.125 | 107.5 | 3.97 | 235 | Sandy loam |
| 2 | 0.98 | 7.97 | 34.4 | 0.112 | 96 | 3.36 | 254.27 | Sandy loam |
| 3 | 1.13 | 7.12 | 37.9 | 0.114 | 98.04 | 3.96 | 269.98 | Sandy loam |
| 4 | 0.96 | 7.55 | 46 | 0.147 | 126.42 | 3.39 | 206.06 | Sandy loam |
| 5 | 1.21 | 7.9 | 28.8 | 0.115 | 98.9 | 4.2 | 227 | Sandy loam |
| Mean | 1.096 | 7.68 | 36.14 | 0.123 | 105.37 | 3.78 | 238.46 | Sandy loam |

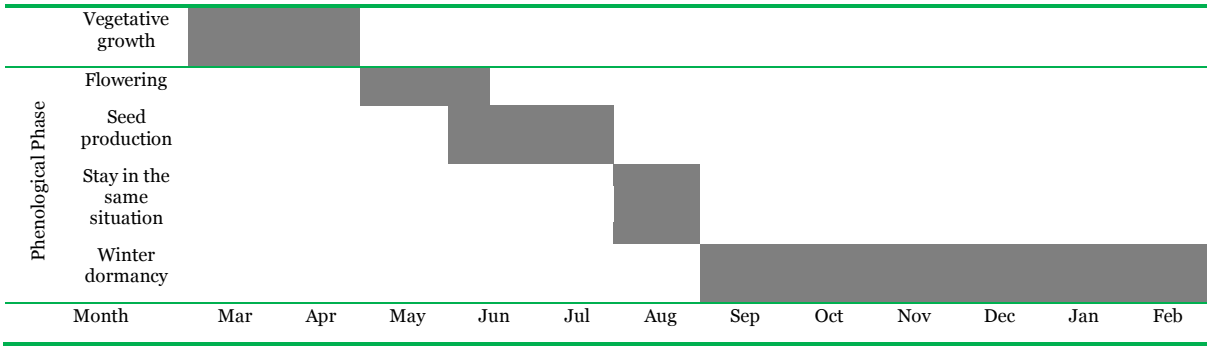
**Table 2.** Chemical analysis of *S. tebesana*.

| Stage | P% | K% | N% | Pro% |
|---|---|---|---|---|
| Vegetative | 0.1 | 0.87 | 0.67 | 4.19 |
| Flowering | 0.11 | 0.92 | 1.05 | **6.56** |
| Seeding | 0.1 | 1.05 | 2.28 | 14.25 |

*Phenology*

Phenological activity is strongly influenced by rainfall and soil moisture. Thus it is the date of occurrence of phenological stages: vegetative growth that began in March to April and continuing. Flowering period begins in May and lasts until mid-June. After this stage, the plant seeding phase. Seed production started almost from the beginning of June and continues until the second half of July. Seeds of the plant have said enough to arrive in early July. In mid-July, the seeds can be separated from the main plant and are scattered around. Finally the leaves and stems remained in the same position until early September.

**Table 3.** Phenological Stage.




*Morphological character*

Plant height of 19-27 cm stems is highly branched and its crack is mediocre. The length and width of leaves are 2-9 and 2-7 mm, respectively. The leaves appear diamond-shaped and it is covered by fine trichomes. It was branched inflorescence and its cycles of flowers are 2-4. Its base is 2 mm calyx tube. It should be said that the calyx flower corolla 3-4 and 5-6 mm. Length and width of the fruit was 2 and 1 mm that the seed glaring black in appearance.

*Co-dominant plant*

Table 4 reveals the Co-dominant plant in the habitat.

**Table 4.** Co-dominant plant in the habitat.

| Plants | Life form | Distribution | Plant | Life form | Distribution |
|---|---|---|---|---|---|
| *Acanthophyllum sordidum* Bunge ex Bioss. | Ch | IT | *Londesia eriantha* Fisch. & C.A.Mey. | Th | IT |
| *Aegopordon berardioides* Bioss. | He | IT | *Lycium depressum* Stocks. | Ph | IT |
| *Alhagi persarum* Bioss. & Buhse. | He | IT | *Nardurus subulatus* (Banks & Soland.) | Th | IT |
| *Amygdalus lycioides* Spach. | Ph | IT | *Nepeta ispahanica* Bioss. | Th | IT |
| *Amygdalus scoparia* Spach. | Ph | IT | *Nonnea persica* Bioss. | He | IT |
| *Artemisia sieberi* Besser. | Ch | IT | *Onobrychis plantago* Bornm. | He | IT |

| | | | | | |
|---|---|---|---|---|---|
| *Astragalus (Poterium) arbusculinus* | Ph | IT, SS | *Pteropyrum aucheri* Jaub. & Spach. | Ph | IT |
| *Avene fatua* L. | Th | Cosm | *Peganem harmala* L. | He | IT |
| *Boissiera squarrosa* (Banks & Soland.) Nevski. | Th | IT | *Pennisetum orientale* L. C. Rich. | Ge | IT |
| *Bromus danthoniae* Trin. | Th | IT | *Phagnalon nitidum* Fres. | He | IT |
| *Bromus tectorum* L. | Th | IT | *Plantago ciliate* Desf. | Th | IT,SS |
| *Callipeltis cucularis* (L.) Stev. | Th | IT | *Prosopis farcta* (Banks & Soland) | Ch | IT,M,SS |
| *Chrozophora tinctoria* (L.) A. Juss. | Th | IT,M | *Psammogeton canescens* Dc. | Th | IT |
| *Cousinia onopordioides* Ledeb. | He | IT | *Pulicaria gnaphaloides* Vent. | He | IT,SS |
| *Cymbopogon olivieri* (Boiss) Bor. | He | IT,SS | *Pycnocycla nodiflora* Decne. ex Boiss. | He | IT |
| *Enneapogon persicus* Bioss. | He | IT | *Rehum ribes* L. | Ge | IT |
| *Ephedra intermedia* Schr. | Ch | IT | *Rumex vesicarius* L. | Th | IT,SS |
| *Eremopyrum bonaepartis* (Spreng.) Nevski. | Th | IT | *Salvia lerifolia* Benth. | He | IT |
| *Eremurus persicus* (Jaub. & Spach) Bioss. | Ge | IT | *Scabiosa olivieri* Coult. | Th | IT |
| *Eremostachys macrophylla* Montbr. & Auch. | He | IT | *Scorzonera ramosissima* DC. | Ge | IT |
| *Ferula assa-foetida* L. | He | IT | *Scrophularia striata* Bioss. | He | IT |
| *Ficus johannis* Bioss. | Ph | IT,M | *Senecio glaucus* L. | Th | IT,SS,M |
| *Gymnocarpus decander* Forssk. | Ch | SS | *Stipa barbata* Desf. | He | IT |
| *Hordeum glaucum* Steud. | Th | IT,M | *Stipa parviflora* Desf. | He | IT,M |
| *Hyoscyamus pusillus* L. | Th | IT | *Teucrium polium* L. | He | IT,M |
| *Koelpinia tenuissima* Pavl. & Lipsch | Th | IT | *Zataria multiflora* Bioss. | PH | IT,SS |
| *Lactuca orientalis* Boissier. | He | IT | *Ziziphora tenuir* L. | Th | IT |
| *Launaea oligocephala* (Hausskn. Ex Bornm.) | He | IT, SS | *Zoegea purpurea* Fresen. | Th | IT,SS |

Ch = Chamaephyte, Ge = geophyte, He = Hemicryptophyte, Ph = Phanerophyte, Th = Therophyte

IT: Iran Torania, SS: Sahara Sandy, M: Mediterranean, Cosmo: Universe, Es: Europe Siberia

## Discussion

An area where the only habitat of *S. tebesana* was identified in Tabass, Iran. The mean annual rainfall and temperature were about 123.1 mm and 17.7°C for this habitat, respectively, with the bulk of the rains concentrated in winter. Using the De Martonne and Ambrge climate classification, the habitat of the plant was categorized as arid and semi-arid. Danin (2008) stated that the edaphic factor has a high impact on the distribution of plants in desert areas. Soil texture, pH, EC and SAR were more important factors than others among the soil properties.

For example, this plant was more abundant on soils with pH that varied from 7.12-7.97 and Ec ranged 0.96 to 1.21 DS/m. This is consistent with the findings reported with Kaya and Aksakal (2007) can tolerate soil pH 6.95-8.01. The plant grows on sandy-loam texture. *S. rosifolia* and *S. wiedemannii* have also been reported to prefer same soil (Kaya and Aksakal, 2007). The content of nitrogen, phosphorus and potassium in the soil varied 96-126.42, 3.36-4.2 and 206.06-269.98 ppm, respectively. The study of chemical analysis of the plant revealed that three important elements (N, P, and K) had increased except phosphorus that was almost constant trend. *S. tebesana* started vegetative growth in March and reached peak growth in April and fully flowered from May until mid June. Seed production started almost from the beginning of June and continues until the end of July. In mid-July, the seeds can be separated from the main plants. The results of the present survey were different with research on *Dracocephalum kotschyi* Bioss. and *Thymus pubescens* Bioss. & Kotschy ex Celak in Iran (Asaadi and Khoshnod Yazdi, 2010; Yavari *et al*., 2011). The new plant not found in the region. *S. tebesana* produced large amounts of seeds in its habitat, but it was not able to reproduce by seed in the habitat due to having the locally harsh environmental conditions and maybe tiny seeds. According to the outcome, domestication and breeding program are urgently required for the conservation of this valuable but endangered species. Height of the plant is 19-27 cm and the length and width of leaves are 2-9 and 2-7 mm, respectively. The leaves appear diamond-shaped. It was branched inflorescence and its cycles of flowers were 2-4. It should be said that the calyx flower corolla 3-4 and 5-6 mm. Length and width of the fruit was 2 and 1 mm, which the seed glaring black in appearance. Native plant species that have evolved within these regions are perfectly adapted to thrive in the current climate, soil, and environmental conditions. *S. tebesana* is a native plant species in Tabass that has adapted perfectly to unfavorable environmental conditions such as periodic drought, seasonal wind and extreme temperatures.

It can be effectively used for rehabilitation of desertified rangeland and improvement of degraded rangeland. In addition, *S. tebesana* could be a good fodder resource for animal in its regions due to its relatively high protein content (14.25%) during seeding growth. Peak seeding growth is the best harvesting and grazing time of this species but if essential oil was important, flowering is the best time.

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