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Ecological characteristics of *Panicum turgidum* in hormozgan province

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Abstract
Panicum turgidum is one of the most important species of Hormozgan coastal rangelands, playing an important role in terms of soil conservation and forage production. This research was conducted in 2011 to investigate the ecological characteristics of *Panicum turgidum* in Hormozgan. In this research, the distribution map of the species was prepared initially and then studies were performed in Jask, Kerian and Divan. Altitudinal range of this species varies from near sea level in Qeshm Island to 100 m above sea level at Charak port, and it is mainly observed in very light-textured soils as well as stabilized sand dunes. Geological units of the study area include transverse sand dunes and sandy zones. In terms of land capability maps, this species is observed in land units including 3.5, 8.1, 8.2, and X.2. The highest and the lowest canopy cover percentage were recorded for Jask (11.8%) and Kerian (6.05%), respectively. In terms of density, the highest and the lowest values were recorded for Jask and Kerian, respectively. Soil characteristics including EC (0.43-5.93), pH (7.69-8.75), lime (26.43-60.69) and sand percentage (67.68-91.33) were measured. According to the results, little differences were found for pH, EC, and OC among all studied sites. Overall, climate is the main factor for species distribution in the province and considering almost similar conditions in the habitats of the species, the changes in the plant parameters could be attributed to soil factors.

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Introduction

Range management is based on ecological principles and understanding of ecological processes is the main prerequisite for management. Different aspects of range utilization could be discussed more accurately by the evaluation of ecological conditions and factors affecting vegetation (Moghadam, 2001). Factors influencing the distribution of plants may be due to the characteristics of the plant or the environment or both (Ardakani, 2003). All ecological, climatic and soil factors play an efficient role in determining the plant habitat and biome distribution. Therefore, this study was designed and conducted in the coastal of Hormozgan province. Overall, the main objective of this study was to determine the factors affecting plant distribution and determine the limiting factors of

distribution and growth of *Panicum turgidum* in Hormozgan Province. This species is distributed in Iran, Jordan, Bahrain, Pakistan, Iraq, Saudi Arabia, Palestine, Cyprus, Kuwait, Egypt and tropical regions of Africa. In Iran, it is mainly distributed in sandy areas near the beaches of Khalij-O-Omani region including south, southwest, and southeast of Hormozgan and Sistan and Balouchestan provinces. The flowering stage starts from late March.

In Hormozgan province, this species grows on sand dunes, covering a considerable surface of Hormozgan rangelands. It is worth noting that this area is located in the coastal areas and sand dunes on which few species can grow (Fig. 1).
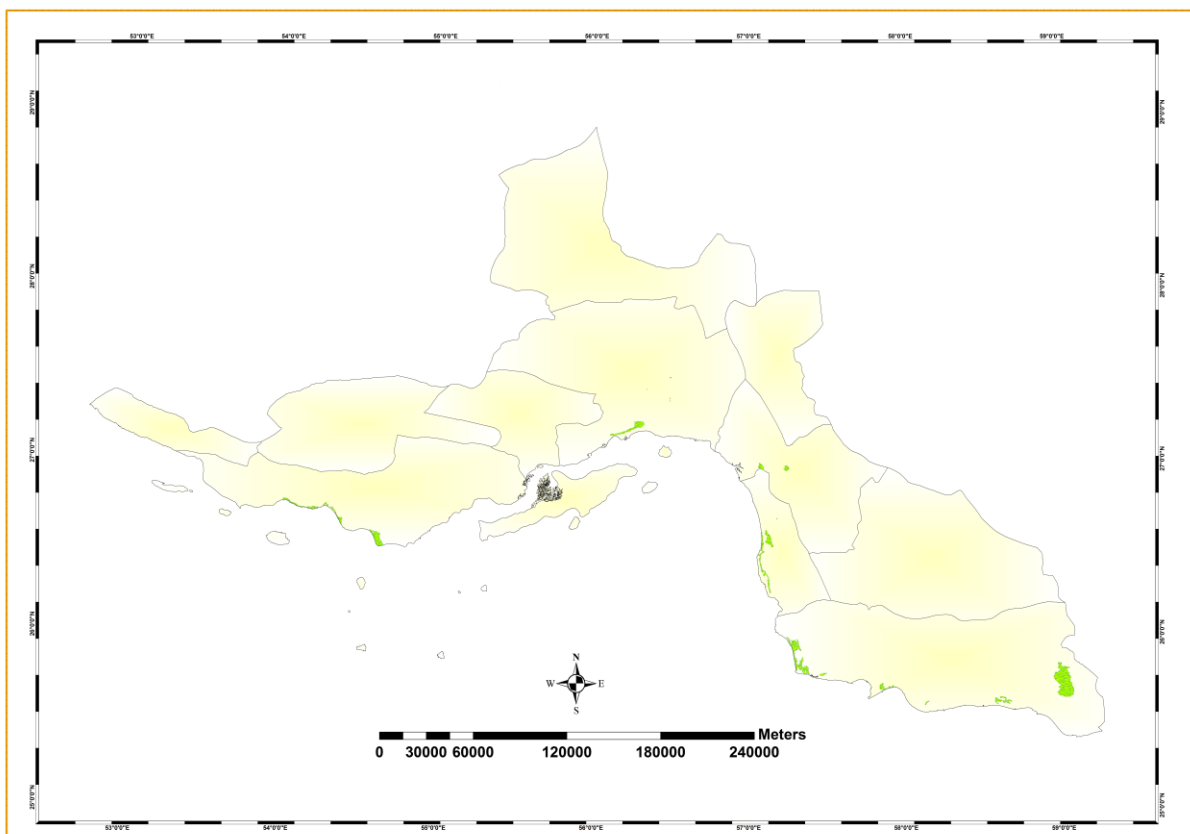
Fig. 1. Distribution of *Panicum turgidum* in Hormozgan province.

Although studies have been conducted on this species worldwide, no study has been performed to investigate the ecological characteristics of this species directly. Roots and root fibers of this species are strong and woody. Root hairs can stick to the fine

sand particles through the excretion of viscous materials and this allows the plant to absorb more moisture from the soil. This species is mainly found in deep sand dunes but it also grows on well-drained soils (Latosol). *Panicum turgidum* is a valuable

species for the stabilization of sand dunes. In terms of rainfall, it grows particularly in a region where rainfall is between 100-400 mm. Much research has been done on autecology of range species in Iran; however, no study has been performed on Panicum turgidum. Some studies in relation to other species are presented as follows:

Zare *et al.,* (2007) studied the relationship between vegetation with soil and landform in Bandar Abbas. According to the results, a significant and positive correlation was found between cover percentage, altitude, and the percentage of slope while there was a negative correlation between EC and cover percentage. In addition, cover percentage showed a significant difference in geopedological units. Other soil properties including pH and soil texture had little effect on vegetation.

Asadpour and Soltanipoor (2009) studied the autecology of Cymbopogon olivieri in Hormozgan province and reported that this species was observed in both Khalij-O-Omani and steppe regions. They concluded that the distribution of this species in adjacent provinces is limited with increasing latitude and decreasing temperature. In addition, climatic factors were not limiting factors in distribution of this species in Hormozgan province. Therefore, the main factor in distribution of this species could be attributed to soil properties and growth substrate.

Kaya and Aksakal (2007) studied the morphological characteristics and autecology of Salvia rosifolia as a native species to Turkey. They found a relationship between phosphorus, nitrogen, and potassium with species distribution in the study area. In addition, a soil pH of 6.95-8.01 was found to be suitable for the growth and distribution of this species.

Abuziyad *et al.,* (2008) investigated the autecology and phytochemical properties of three species of the Amaranthus genus in the Nile Delta.

According to the results, the species distribution was mainly affected by pH, EC, and Na.

The current study was aimed to determine the ecological factors including clime, soil, and geology, affecting the distribution of *Panicum turgidum*. Determining the altitude range of distribution, associate species, density and canopy cover percentage of *Panicum turgidum* were also investigated in Hormozgan province.

Materials and methods
Materials
The investigations were done in three main regions of Hormozgan province (Divan, Karyan andJask). Jask region is located between latitudes 25º 45' 36''to 25º 36' 01''N and longitudes 57º 27' 00''to 57º 29' 24'' E. Vegetation type of this region is *Sphaerocoma aucheri + Panicum turgidum*. Kerian region is located between latitudes 26º 30' 36''to 26º 36' 36''N and longitudes 57º 06' 00'' to 57º 09' 00''E. Vegetation type of this region is *Sphaerocoma aucheri + Panicum turgidum*. Divan region is located between latitudes 26º 29' 26''and 26º 58' 24''N and longitudes 54º 39' 54'' and 39º 54' 56''E. Vegetation type of this region is *Panicum turgidum + Sphaerocoma aucheri*.

Methods
In order to investigate vegetative status of *Panicum turgidum* and its relationship with ecological factors in its natural distribution areas of Hormozgan province, the boundaries of species distribution were depicted on topographic maps of 1:50000 scale using existing maps and frequent visits (Map 1). Then, to investigate the vegetative parameters and to examine factors related to physical and chemical properties of soil on species distribution, three different regions were selected including east and west of Hormozgan province. The selected study areas Jask, Kerian, and Divan represent the regions where *Panicum turgidum* is distributed. To determine the ecological factors including climate, soils, geology, etc. on the distribution and frequency of *Panicum turgidum*,

different parameters including number of species per hectare, frequency, canopy cover percentage and two perpendicular diameters were measured. Sampling was performed by systematic random sampling using plot-transect (Moghadam, 2001) in each selected site. Three transects were established on which plots of 4 and 100 m2 were used to investigate vegetative parameters of shrubs, and tree and bush species, respectively. In the case of other species in each site, canopy cover percentage, number of species per hectare and frequency were calculated. In each site, three soil profiles were dug along the plots No. 1, 5, and 10 and soil samples were taken from the depths of 0-25, 25-50, and 50-75 cm. Soil parameters were tested in soil laboratory (Fakhireh *et al.,* 2010). After determining the number and location of samples, number of plots, and sampling method vegetative parameters were recorded in preliminary forms. In this study, factor analysis was conducted using PC-ORD software (Jafari, 2004).

Results

In this study, 49 species were identified from 24 families of which Chenopodiaceae, Gramineae, Papilionaceae, Mimosaceae, and Boraginaceae were present at all three study areas. Among the identified families, Gramineae and Chenopodiaceae had higher species richness.

According to the results, the highest and the lowest canopy cover percentage, density, and height were recorded in Jask (11.8%, 3150, 37.63 cm) and Kerian (4.05%, 1200, 20.50 cm), respectively. Table 1 shows the measured vegetation parameters at each site.

Table 1. Measured vegetation parameters at each site.

Parameter	Jask	Divan	Kerian
Canopy cover percentage(%)	11.80a	4.68b	4.05b
Height(cm)	37.63a	20.50b	37.43a
Small diameter(cm)	50.23a	36.27a	46.23a
Large diameter(cm)	56.97a	43.13a	53.07a
Density(N/ha)	3150a	2336b	1200c

Correlation between environmental and vegetarian factors

The results of correlation between soil properties and vegetation factors of *Panicum turgidum* showed that maximum correlation was found between both diameters and soil saturation percentage in all three depths.

In addition, a correlation was found between the height of *Panicum turgidum* and soil parameters including soil saturation percentage, pH, and sodium absorption ratio in all three soil depths.

Accordingly, a positive and significant correlation was found between canopy cover percentage and soil saturation percentage in all three soil depths.

*Results of principal component analysis of soil parameters using PCORD*

Factor analysis was carried out using PCORD. Results are presented in Table 3. Factor analysis was performed for all traits and two factors explained 100% of the total variance (Table 3), so that the first and the second factors explained the 66.5% and 33.5% of the total variance, respectively .

Table 2. Maximum and minimum values of soil properties in the studied sites.

Domain	sites	Sp	Ec	pH	T.N.V	Gyps	Oc	N	P	K	Sand	Silt	Clay	Ca+Mg	Na	S.A.R	K +
Max	Jask	33.97	2.87	8.64	42.88	0.0	0.32	0.03	5.89	154.0	90.67	6.67	12.67	12.8	19.39	8.91	68.83
Min	Jask	31.64	0.88	8.13	27.88	0.0	0.15	0.02	1.47	85.33	82.67	2.67	6.67	3.73	5.0	3.69	23.33
Max	Divan	34.79	4.96	8.75	60.69	28.0	0.39	0.04	7.5	209.33	90.67	22.0	14.67	27.53	24.07	10.1	81.67
Min	Divan	25.67	0.52	7.69	26.42	0.0	0.04	0.0	0.73	40.67	68.67	2.0	6.0	1.87	1.5	1.05	6.27
Max	Kerian	31.78	5.93	8.53	29.68	0.0	0.13	0.01	4.53	202.67	91.33	7.33	11.33	17.33	43.83	1.2	40.4
Min	Kerian	27.77	0.42	8.22	28.50	0.0	0.04	0.0	1.74	68.0	83.33	2.0	5.33	2.07	1.93	0.18	8.57
Max	Total	31.78	5.93	8.75	60.69	28.0	0.39	0.04	7.5	209.33	91.33	22.0	14.67	27.53	43.83	10.1	81.67
Min	Total	25.67	0.42	7.69	26.43	0.0	0.04	0.0	0.73	40.67	68.67	2.0	5.33	1.87	1.5	0.18	6.27

Table 3. Average values of soil properties.

sites	Sp	Ec	pH	T.N.V	Gyps	Oc	N	P	K	Sand	Silt	Clay	Ca+Mg	Na	K +
Jask	32.43	1.91	8.36	36.21	0.00	0.21	3.72	108.44	86.44	4.15	9.41	6.87	12.00	6.54	38.72
Kerian	32.48	1.87	8.37	36.50	0.00	0.21	3.74	108.53	86.46	4.22	9.31	6.84	11.70	6.40	36.27
Divan	24.83	1.39	8.20	59.83	0.00	0.11	3.89	62.22	20.56	89.63	3.41	6.81	6.33	7.44	4.19
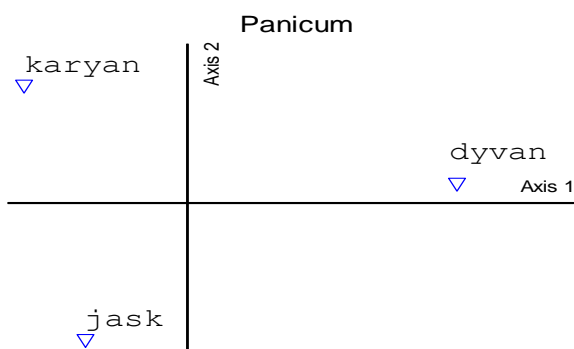
Fig. 2. PC Ordination between the study sites of *Panicum turgidum* and soil properties.

Variables

According to diagram 5, Divan was affected by the first axis. The discriminant factors of this axis included EC of the first and second depths, pH of the first depth, potassium of the second depth (negative) and sand percentage of the second depth (positive).

Kerian was evenly affected by the first and second axes (negative and positive, respectively).

The discriminant factors of the first axis for Kerian included EC of the first and second depths, pH of the first depth, potassium of the second depth (positive), and sand percentage of the second depth (negative).

The discriminant factors of the second axis for Kerian included organic carbon of the first and second depths (negative), total calcium and magnesium of the second depth (negative), and silt percentage of the second depth and total calcium and magnesium of the first depth (positive).

Jask was negatively affected by the influencing factors of the second axis. The discriminant factors of this axis included the organic carbon of the first and second depths (positive), total calcium and magnesium of the second depth (positive), silt

percentage of the second depth and total calcium and magnesium of the first depth (negative).

Overall, both physical properties including sand and silt percentage, and chemical properties including total calcium and magnesium, potassium, pH, EC etc could be evaluated as important factors in the separation of different habitats of *Panicum turgidum*.

Discussion

In addition to the rainfall regime, soil condition is an important factor in providing the moisture needed for plant.

The average root length of the studied species varied from 38.5 to 65.5 cm in different study sites. This species, having shallow roots, is able to use temporary rain and dew.

It is noteworthy to state that in all dug soil profiles, after removing a layer of 3-5 cm, a large volume of felt-shaped roots is appeared and it seems that the depth of these shallow roots indicates the penetration depth of dew and fog. In addition, these shallow roots can use the temporary cloudbursts of the region.

The penetration of water vapor in the space between the sand particles, on humid days when air humidity is high, was reported by Ruhipoor (2004).

Fog is another important source of water supply in the sandy lands of arid regions, absorbed and consumed by aerial parts of plants. In relation to soil texture, low capillary force of sandy soils compared to heavier soil textures is another factor leading to moisture storage in sand dunes. The above factors causes an easier establishment of vegetation in sand dunes compared with clay soils, due to the water supply required for plant growth.

In coarse-textured soils, similar to the habitat of *Panicum turgidum*, soil development is low due to prevailing dry climate and that water is removed from the soil rapidly. According to the obtained results, pH did not vary significantly in the study sites, ranged between 8.2-8.36 (Divan and Jask regions). This indicates that the soil of the study sites is alkaline. Therefore, pH could be a limiting factor.

Average electrical conductivity ranged between 1.39 mmhos/cm (Divan) and 1.91 mmhos/cm (Jask). In addition, average sodium absorption ratio (SAR) ranged between 6.4 (Kerian) and 6.54 (Jask), indicating a non-saline soil.

Overall, the highest correlation was found between vegetative parameters and soil properties including saturation percentage and sodium absorption ratio. This shows the effect of soil texture and soil salinity on the growth parameters of the study species. This finding is not in agreement with the results of Zare *et al.,* (2007), showing a negative correlation between canopy cover percentage and EC. They also mentioned that soil properties including pH and soil texture had no significant effect on vegetation. Asadpour and Soltanipoor (2009) in an investigation on *Cymbopogon olivieri*, stated that climate factors were not significant limiting factor in the distribution of this species in Hormozgan province. This result is in contrast with our results, since climate factors are highly influential in the distribution of *Panicum turgidum.*

Abu Ziad *et al.,* (2008) studied the autecology and phytochemical properties of three species from genus Amaranthus, and introduced EC, pH and sodium as the most important determinants of species distribution. However, for *Panicum turgidum*, climate factors were effective in species distribution in the province and soil factors affected the growth parameters of *Panicum turgidum*.

Kaya and Aksakal (2007) in a study on morphological properties and autecology of *Salvia rosifolia* showed that soil phosphorous, nitrogen and potassium affected the distribution of this species.

Considering that canopy cover percentage and height of this species in the study units have difference with each other and since the climate of the study sites is approximately the same, so the differences must be related to soil properties.

According to the abovementioned, pH, EC, organic carbon percentage, etc did not vary significantly in the study sites and it seems that they had no influential effect on diameter, canopy cover percentage and height of *Panicum turgidum*.

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