

# SCREENING OF HALOPHYTES AS SEED CROPS FOR CULTIVATION IN DESERTS OF MAKHRAN COAST USING SEAWATER

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## ABSTRACT

*Coastal areas of Pakistan including Rann, Thar, Bella and Makhran have little or no productivity. It is estimated that there are at least 72,500 km<sup>2</sup> of land which can easily be irrigated by sea water. The prime need here is to screen the halophytes with oil producing seeds and attempt to grow them in coastal saline desert conditions. Seeds of halophytes represent a potential nutrient source because they are a concentrated food and seed are normally much lower in their salt content than shoots and roots of the sample plant even when they are grown in saline conditions. We hope to produce seed crop using sea water irrigation. To achieve this objective we are conducting phytosociological survey of coastal marshes and deserts, determining the chemical and physical properties of the soil, species soil relationship. We hope to select few native halophytes to screen for seed crop and their sensitivity of sea water irrigation shortly. The data so far accumulated will be discussed.*

## INTRODUCTION

The rapidly growing demand for increased food, fiber, and fuel in the face of rapidly declining availability of agricultural land due to increased soil salinity makes it imperative that crop production under saline conditions be significantly increased (Staples and Toenniessen 1984, Toenniessen 1984, Ahmad and San Pietro, 1986, Barrett-Lennard *et al.* 1986, Pasternak 1987, Goodin *et al.* 1980, Ismail *et al.* 1990, Glenn *et al.* 1991). Many of the arid lands are located along sea coasts or at least within a distance which would make it possible for the sea water to be pumped into agricultural lands. Coastal areas of Pakistan including Rann, Thar, Bella, and Makhran have little or no productivity. It is estimated that there at least 72,500 km<sup>2</sup> of land which can easily be irrigated by sea water, not counting the inland and brackish areas. The prime need here is to screen the halophytes with oil producing seeds and attempt to grow them in coastal saline desert conditions (Yenesen and Bedell 1990). Seeds of halophytes represent a potential nutrient source because they are a concentrated food source and seeds are normally much lower in their salt content than shoot or roots of the same plant even when they are grown in saline conditions (Khan and Ungar 1985). Thus the seeds may be the most likely part of a halophyte to find immediate use (O'Leary 1984, Glenn *et al.* 1991). The reason for seed crop not having been considered as likely initial success as forage/fodder crops by most people

probably is due to the relatively small seeds normally found along halophytes. However, if the number of seeds produced per plant is high enough, even with the very small seeds, the seed yield per unit of land could be high. Glenn *et al.* (1991) reported that *Salicornia bigelovii* gives a 6 year mean seed yield of 2 metric tons hectare<sup>-1</sup>. Furthermore, the nutritional qualities, baking characteristics and taste of flour from *Distichlis* seeds compares more favourably with wheat flour (Yensen 1987, Yensen *et al.* 1985). Increased attention should be given to look for potential oilseed or grain halophytic crops. The advantage of having a crop with two able products (vegetable oil and protein rich meal) increases the chance of it becoming a successful, economically feasible crop (O'Leary 1984). Halophytes are already used as forage in some areas but the real impact on the crop production would be in development of halophytic seed crops, and that is where the major interest is focussed.

The coastal region of Balochistan contributes a major part (640 Km) starting from Bella including Makran upto Iranian border. Ecological survey of the entire area is poor. Few studies discuss the halophytic stands present around coastal and inland areas of Karachi (Chaudhri and Qadir 1958, Chaudhri 1961, Chaudhri *et al.* 1966, Chaudhri and Chuttar 1966, and Qadir *et al.* 1966, Ahmad 1987). These reports are preliminary and subjective and provide sketchy and incomplete picture of the sea. However, Ahmad (1987) reported a relatively more detailed analysis of the area. Thirty stands were sampled located in and around small towns present along the Balochistan coast, this represents a sort of a pilot study requiring a more carefully planned detailed study to answer relevant questions. It will be very important to correlate distribution of species with soil characteristics like pH, conductivity, CaCO<sub>3</sub>, and other essential mineral elements. This data regarding the availability of native species and their species soil relationship will provide a basis for screening and establishment of selected species.

The aim of the project is the screening of local coastal halophytic species capable of producing seed crop for oil and/or protein, which can be grown in coastal saline desert of Pakistan using sea water. The study will provide a better understanding of halophytic wealth present in Pakistan and their species to soil relationships. Potential species with oil producing seeds, their germination requirements and their cultivation under field conditions with sea water irrigation will also be studied. The study will include phytosociological survey of coastal salt marshes and salt deserts of Pakistan. Chemical and physical properties of the soil, and their bearing on species-soil relationships in various saline habitats will receive attention. Potential halophytic species will be screened for oil and protein contents of their seeds. Species which have higher oil and protein contents will be selected for germination studies and will be cultivated in coastal areas using seawater.

This paper represents the data so far obtained from coastal areas of Balochistan.

## MATERIALS AND METHODS

Coastal areas of Pakistan is located along the Arabian sea at a latitude of 24° 26'N and longitude of 62° 68'E. The area is extremely arid and climate has been characterized as subtropical maritime desert (Chaudhri 1961). Ahmad (1951) divided this area into two regions: a. Makran and Lasbella coast, b. Lower Sindh coast. Annual rainfall decreases from 220 mm to around 25 mm as we move westward. Eastern half of the coast receives summer rain while western half gets winter rains. Rain pattern of the entire area is erratic. The mean maximum temperature ranges from 32-40C some times reaching as high as 48C whereas mean minimum temperature ranges from 14-18C. Strong coastal winds are characteristic of the region. Humidity is high with occasional dew formation.

Sampling area was divided into 4 major habitat types. 1. Sindh coastal 2. Sindh near coastal 3. Balochistan coastal 3. Balochistan near coastal (Coastal areas are those which are inundated with seawater at least once a month and those which are in close vicinity of the coast (10 miles) are regarded as near coast areas). A reconnaissance survey and pilot study has been preceded the vegetational sampling. In each type of vegetation (community) at least 40 stand were sampled using Releve' method of Z.M. School (Becking 1957). Criteria for the selection of a stand was adequate size of the sample area, visual homogeneity of vegetation and physiography. Sociability, domien and cover was measured from which relative value was estimated.

## Results

Coastal area of Balochistan was sampled. Samples are grouped into 6 different areas of Balochistan coast. These areas are Jiwani, Gwadar, Pasni, Ormara, Sonmiani and Gaddani. Table 1 represent the data of 9 stands sampled in Jiwani. Vegetation is dominated by *Halopapulus perfoliata*, *Arthrocnemum indicum* and *Urochondra setulosa*. The area have relatively high diversity represented by 10 halophytic species.

The results presented in Table 2 represent the data of 8 stands in and around Gwadar areas. Vegetation shows very low diversity and is represented by only 3 species. *Halopyrum mucronatum* usually dominated the communities followed by *Suaeda fruticosa* and *Cyperus sp.*

The area classified as Pasni show a quite diverse vegetation. This area is represented by 12 halophytic species. This area is primarily

dominated by *Suaeda fruticosa* and *Indigofera argenticia*. Areas with frequent inundation of sea water was dominated by *Arthrocnemum indicum* and *Halopyrum mucronatum*.

Eastern side of Balochistan coast classified as Ormara group also dominated by *Halopyrum mucronatum* and *Suaeda fruticosa*. Diversity in this area is very low and represented by only 5 species (Table 4).

Vegetation of Sonmiani is represented in Table 5. Vegetation of this area is represented by *Suaeda fruticosa*, *Arthrocnemum indicum*, and *Salsola baryosma*. Table 6 represents the vegetation of Gadani adjacent to Sindh coastal areas. Here vegetation is primarily dominated by *Suaeda fruticosa*, *Halosarchia persica* and *Arthrocnemum indicum*.

## DISCUSSION

The vegetation in the surveyed area exhibit local differences owing to varied physiographic conditions. All the coastal areas are primarily dry with annual rainfall in some area less than 100 mm. The area closed to Iranian border, which is characterized as Jiwani have sandy soil with high moisture conditions most probably due to low water tables. This area is largely flat plains devoid of any rocks and sand dunes. Temperature of the area never goes above 34°C during summer with low wind velocity. This area is primarily dominated by pure stands of *Halopappus perfoliata*, *Arthrocnemum indicum* and *Halopyrum mucronatum*.

Gwadar was the next vegetation zone studied and was characterized by dry sandy soil with characteristic dune formation. The temperature of the area is very high with high wind velocity resulting into frequent dust storms causing soil erosion. This area is dominated by *Halopyrum mucronatum*, *Suaeda fruticosa* and *Cyperus sp.* Diversity of the area is low.

Area around Pasni also characterized by high wind velocity and dust storms. They also have stable and embryonic sand dunes. Western part of the area have dry soil red in colour with embryonic dunes dominated by *Halopyrum mucronatum* and *Indigofera argentea*. Eastern part of this area is characterized by saline marshy area and adjacent small stable sand dunes. Marshy area dominated by *Arthrocnemum indicum* and *Cressa cretica*. Whereas sand dunes are inhabited by *Suaeda fruticosa* occurring with *Halopyrum mucronatum*.

Ormara is characterized by high temperature and high wind velocity with frequent soil erosion. Embryonic sand dunes are found

**Table 1: Phytosociological attributes of the flora comprising Jiwani Coastal areas.**

Specimen Name.	Cover	Soc.	Domine	Total	% rep.	Relative rep.
<i>Halopappus perfoliata</i> (H*)	7.00	15.00	17.00	39.00	55.00	23.80
<i>Arthrocnemum indicum</i> (H)	3.00	7.00	9.50	19.50	44.00	19.00
<i>Halopyrum mucronatum</i> (S <sub>2</sub> )	5.00	4.00	9.00	18.00	22.00	09.50
<i>Urochondra setulosa</i> (S <sub>2</sub> )	3.00	6.00	8.00	17.00	33.00	14.20
<i>Suaeda fruticosa</i> (S <sub>2</sub> )	3.00	3.00	6.00	12.00	11.00	04.70
<i>Aelorous lagopoides</i> (H)	1.00	5.00	4.00	10.00	22.00	09.50
<i>Cyperus sp.</i> (H)	2.00	1.00	4.00	7.00	11.00	04.70
<i>Cressa cretica</i> (H)	2.00	1.00	2.00	5.00	11.00	04.70
<i>Bienertia cycloptera</i> (H)	0.50	1.00	3.00	4.50	11.00	04.70
<i>Salsola baryosma</i> (H)	0.50	2.00	0.50	3.00	11.00	04.70

\* H= herb strata, S<sub>2</sub>= small shrub, S<sub>1</sub> = large shrub

**Table 2  
Phytosociological attributes of the flora comprising Gwadar Coastal Areas**

Species Name	Cover	Soc.	Domine	Total	% rep.	Relative Rep.
<i>Halopyrum mucronatum</i> (S <sub>2</sub> )	5.00	4.00	9.00	18.00	100.00	50.00
<i>Suaeda fruticosa</i> (S <sub>2</sub> )	3.00	3.00	6.00	12.00	050.00	25.00
<i>Cyperus sp.</i> (H)	2.00	1.00	4.00	07.00	050.00	25.00

Table 3: **Phytosociological attributes of the flora comprising Pasni Coastal areas.**

Species Name	Cover	Soc.	Domine	Total	% rep.	Relative rep.
<i>Suaeda fruticosa</i> (H)	09.50	10.00	16.00	35.50	50.00	19.00
<i>Desmostachya bipinnata</i> (S <sub>2</sub> )	10.00	08.00	16.00	34.00	25.00	09.50
<i>Cressa cretica</i> (S <sub>2</sub> )	07.00	08.00	12.00	27.00	25.00	09.50
<i>Indigofera argentea</i> (H)	06.50	08.00	11.00	25.50	50.00	19.00
<i>Suaeda vermiculata</i> (S <sub>2</sub> )	04.00	04.00	06.00	14.00	12.50	04.70
<i>Urochondra setulosa</i> (S <sub>2</sub> )	04.00	04.00	06.00	14.00	12.50	04.70
<i>Arthrocnemum indicum</i> (H)	04.00	04.00	05.00	13.00	12.50	04.70
<i>Atriplex leucoclada</i> (S <sub>2</sub> )	04.00	02.00	08.00	14.00	25.00	09.50
<i>Halopyrum mucronatum</i> (S <sub>2</sub> )	03.00	03.00	04.00	10.00	12.50	04.70
<i>Heliotropium sp.</i> (H)	02.00	02.00	03.00	07.00	12.50	04.70
<i>Zygophyllum propinquum</i> (H)	01.00	02.00	02.00	05.00	12.50	04.70
<i>Zygophyllum simplex</i> (H)	00.50	01.00	01.00	02.50	12.50	04.70

Table 4: **Phytosociological attributes of the flora comprising Ormara coastal areas.**

Species Name.	Cover	Soc.	Domine	Total	% rep.	Relative
<i>Halopyrum mucronatum</i> (S <sub>1</sub> )	08.00	10.00	12.00	30.00	50.00	25.00
<i>Paganum hermala</i> (H)	04.00	05.00	06.00	15.00	25.00	12.50
<i>Suaeda vermiculata</i> (S <sub>2</sub> )	04.00	04.00	05.00	14.00	25.00	12.50
<i>Heliotropium sp.</i> (H)	02.00	02.00	03.00	07.00	25.00	12.50
<i>Suaeda fruticosa</i> (S <sub>2</sub> )	01.00	02.00	02.00	05.00	50.00	25.00

Table 5. : **Phytosociological attributes of the flora comprising Sonmiani coastal areas:**

Species Name	Cover	Soc.	Domine	Total	% rep.	Relative rep.
<i>Suaeda fruticosa</i> (S <sub>2</sub> )	08.00	08.00	12.00	28.00	40.00	33.00
<i>Arthrocnemum indicum</i> (S <sub>2</sub> )	06.00	05.00	07.00	18.00	30.00	25.00
<i>Salsola baryosma</i> (S <sub>2</sub> )	06.00	06.00	05.00	17.00	20.00	16.60
<i>Aerva pseudotomentosa</i> (S <sub>2</sub> )	04.00	06.00	05.00	15.00	10.00	08.30
<i>Halopyrum</i> (S <sub>2</sub> )	03.50	05.00	05.00	13.50	20.00	16.60

Table 6: **Phytosociological attributes of the flora comprising Gidani coastal areas.**

Species Name	Cover	Soc.	Domine	Total	% rep.	Relative
<i>Suaeda fruticosa</i> (S <sub>2</sub> )	10.00	10.00	12.00	32.00	37.50	27.27
<i>Halosarchia persica</i> (H)	08.00	10.00	10.00	28.00	12.50	09.09
<i>Arthrocnemum indicum</i> (S <sub>2</sub> )	08.00	06.00	10.00	24.00	12.50	09.09
<i>Salsola baryosma</i> (S <sub>2</sub> )	06.00	06.00	07.00	19.00	25.00	18.18
<i>Atriplex griffithii</i> (H)	04.00	06.00	05.00	15.00	12.50	09.09
<i>Halopyrum mucronatum</i> (S <sub>2</sub> )	03.50	02.00	04.00	09.50	12.50	09.09
<i>Ipomea pescaprae</i> (H)	00.50	01.00	02.00	03.50	12.50	09.09

which are apparently larger in size as compared to those found in Pasni. The vegetation is dominated by *Halopyrum mucronatum*, *Paganum hermala* and *Suaeda vermiculata*.

Gadani and Sonmiani coastal areas are represented by hills, sand dunes marshes. Marshes are dominated by *Halosarchia persica* and *Arthrocnemum indicum*. Sandy area is inhibited primarily by *Suaeda fruticosa*.

We are analyzing data regarding the physical and chemical properties of soil. This data will help in developing species-soil

relationship. We will select those species which are highly salt tolerant and then try them to grow in coastal areas using seawater. Those species which produce seeds with better quality of soil will be screened and the technology will be developed for this cultivation using sea water.

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