



Two populations of *Salicornia europaea* in the United Arab Emirates

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Abstract

The plant *Salicornia europaea* is cultivated for oilseed and as a fodder crop in various parts of the world. Two local populations of the species, in the emirates of Ra's al-Khaimah (RAK) and Umm al-Qaiwain (UAQ), both part of the United Arab Emirates (UAE), were studied. Both of the ecotypes, i.e., RAK and UAQ, grow in coastal areas on the shores of the Arabian Gulf. Studies reveal that they are different genotypes. The UAQ ecotype starts flowering and maturing one week earlier than the RAK ecotype. The spikes of RAK turn yellow before maturing, while those of the UAQ genotype turn pink during the same stage. Data on different characteristics including plant height, plant dry weight, number of branches per plant and number of spikes per plant of the two populations were also taken to identify differences. While the *S. europaea* population in Umm al-Qaiwain is thriving, an invasive halophytic species, *Sesuvium portulacastrum*, is present in some of the area inhabited by the population at Rams, in Ra's al-Khaimah.



Picture1. *Salicornia europaea* growing at the edge of a lagoon at Rams, Ra's al-Khaimah

Introduction

Salicornia europaea, commonly known as glasswort or samphire, is an annual halophyte in the family Chenopodiaceae. It grows in areas of intertidal and inland saltmarshes as well as on the edges of lagoons. The species is one of the most salt-tolerant terrestrial plants and can be cultivated as a vegetable, oilseed and fodder crop using brackish water for irrigation.

Salicornia europaea can be eaten either fresh or cooked. While it has long been used as food, especially in northern Europe, in recent years it has attained popularity as a gastronomic delight in fashionable restaurants. It is generally steamed or cooked in a microwave, followed by light frying in butter or olive oil.

The seed oil of *S. europaea* is very nutritive with high health benefits (Liu *et al.*, 2005) compared with other halophytes (Roshandel and Shamsi, 2015). The oil contains five main fatty acids including stearic acid (2.37%), linolenic acid (2.63%), palmitic acid (7.02%), oleic acid (13.04%) and linoleic acid (75.62%) (Liu *et al.* 2005). The majority of the fatty acids found in the oil are unsaturated, e.g. linoleic acid and oleic acid, considered beneficial for human health.

Other species of the genus *Salicornia* have successfully been used as fodder in the USA (Glen *et al.*, 1998) and Kuwait (Abdal, 2009). *Salicornia* seed meal can also be used as a protein supplement in feeds of different livestock animals (Glen *et al.*, 1998).

Studies on various halophytes have shown that they contain many compounds which have medicinal properties, including anti-inflammatory, anti-tumour, antimicrobial and antioxidant (Rhee *et al.*, 2009). These compounds help to fight acute inflammation, cancers, cardiovascular disorders and some infectious diseases, as well as help in slowing the ageing process (Ksouri *et al.* 2011). A study of *Salicornia herbacea* (a synonym of *S. europaea*) showed that it contains tungtungmadic acid, quercetin 3-O-glucoside, and isorhamnetin 3-O-glucoside, which are anti-inflammatory, immunomodulatory and antioxidative in nature (Rhee *et al.*, 2009).

The species is native to North America, Europe and South-west and East Asia (Bojian *et al.*, 2003). In the Arabian Peninsula, it has been reported from Kuwait (Oman, 2001), Qatar (Norton *et al.*, 2009), Saudi Arabia (Chaudhary, 1999) and the UAE (Brown and Sakkir, 2004).

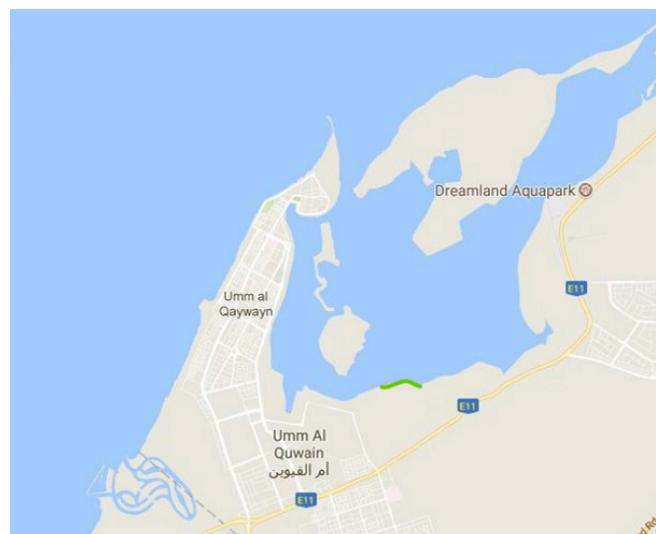




Map 1. The red arrows indicate the sites where UAE *Salicornia europaea* populations were studied



Map 2. At Rams, Ra's al-Khaimah, the *S. europaea* population site in green



Map 3. The green area shows the location of the *S. europaea* population in the Khor al-Beida, Umm al-Qaiwain.





Table 1. Seven different characteristics of two ecotypes of *Salicornia europaea* of the United Arab Emirates studied during 2015-2016

Characteristics	Populations	
	RAK	UAQ
	Mean \pm SD	Mean \pm SD
Plant height (cm)	39.9 \pm 2.1	44.8 \pm 2.4
Plant dry weight (g)	38.6 \pm 2.6	48.3 \pm 4.5
Number of branches/plant	28.8 \pm 1.4	36.4 \pm 1.7
Number of spikes/plant	321.1 \pm 37.3	446.1 \pm 43.4
Spike color	Yellow	Pink
Start of Flowering	Second week of November	First week of November
Start of Maturity	Third week of December	Second week of December

Materials and Methods

Two populations of *Salicornia europaea* in the United Arab Emirates (UAE), from Rams [N 25°53.062, E 056°00.760, (Picture 1)], in Ra's al-Khaimah, and in Umm al-Qaiwain [N 25°31.805, E 055° 35.335, (Photo 2)] were studied to identify differences between them. Both populations are located on the edge of coastal lagoons, around 60 km. apart (Map 1). At Rams, the *S. europaea* population was growing on the shores of a narrow lagoon with an average width of around 130 m (Map 2). At high tide, the *Salicornia* plants are submerged in water (Picture 3). No other plant species were found to be growing in direct association with them. The second *Salicornia* population was found on the edge of the large Khor al-Beida lagoon in Umm al-Qaiwain (Map 3). A mangrove species, *Avicennia marina*, was also present.

The study of the two *S. europaea* populations was carried out during 2015-16. Various plant traits including days to flowering, days to maturity, plant height, plant dry weight, the number of branches per plant, spike colour and the number of spikes per plant were studied to identify difference between the two *S. europaea* ecotypes. Data on twenty-five plants selected at random from each population were measured for the agronomic characteristics. A Garmin GPS 72H was used to record the geographical co-ordinates of the *Salicornia* populations, while data on the habitats were also recorded.

The data were analysed using standard statistical methods to ascertain significant differences between the *Salicornia* ecotypes for the four different morphological characteristics.



Picture 2. *Salicornia europaea* population at Umm al-Qaiwain, UAE





Picture 3. At high tide, *Salicornia europaea* plants submerged in water at Rams, Ra's al-Khaimah



Picture 4. The spike colour of *Salicornia europaea* ecotype RAK growing at Rams.



Picture 5. The spike colour of the UAQ ecotype of *Salicornia europaea* found at Khor al-Beida.



Picture 6. *Sesuvium portulacastrum* invading the *Salicornia europaea* habitat at Rams.





Results

The study of various agronomic traits of the two *Salicornia europaea* populations in the UAE reveals that they are separate ecotypes with distinct characteristics (Table 1). The UAQ *Salicornia* population starts flowering in the first week of November and matures in the third week of December. The RAK population begins flowering in the third week of November, maturing in the last week of December. The spike colour of the RAK ecotype is yellow (Picture 4), whereas it is pink for the UAQ ecotype (Picture 5). As for plant height, the mean of the RAK ecotype is about 40 cm, while the UAQ ecotype stands around 45 cm, a difference of 11 per cent. Plant dry weight of the UAQ ecotype is 48 g, more than 20% greater than RAK (38.6 g). As for the number of branches per plant, the UAQ ecotype has more than 36, while the RAK ecotype has less than 29. The maximum variation between the two *S. europaea* ecotypes was observed for their number of spikes per plant. RAK has 320 and UAQ 446, a difference of more than 28% between the two populations for this characteristic.

The Umm al-Qaiwain population of *S. europaea* appear to be in a stable condition without any immediate threat from development or invasive plants. At Rams, an introduced halophytic species, *Sesuvium portulacastrum* was observed in the vicinity. This appears to have affected the growth of *S. europaea* there (Picture 6). Eradication of the invasive species from the site could be considered.

Conclusion

The two populations of *Salicornia europaea* at Rams, Ra's al-Khaimah (RAK) and Umm al-Qaiwain (UAQ) are different and can be classified as two ecotypes with distinct characteristics. The RAK ecotype may be threatened as a result of the invasion of a foreign halophyte, *Sesuvium portulacastrum*. Observation and possible eradication of this introduced invasive species may be necessary to prevent the disappearance of this unique UAE *Salicornia* population.

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