Summary

Saline agriculture can facilitate the adaptation to the increasing salinization and decreasing availability of fresh water. Also, many salt affected soils considered to be unsuitable for agriculture, can be turned into productive agricultural areas. In this way, salinization can be regarded as an opportunity for sustainable exploitation of saline resources, in contrast to the negative association that salinization often evokes. Although the concept of saline agriculture is not new, only limited research has been undertaken which has been insufficient to allow large scale saline agriculture. First, there is a need to evaluate the salt tolerance of plant species that can be cultivated as crops under saline conditions. Since most conventional crops are relatively sensitive to soil salinity and can only be cultivated under ‘moderately’ saline conditions (up to circa 20 % seawater salinity), the domestication of halophytes is an approach that should be considered. Knowledge of the ecology and ecophysiology of a species can help to evaluate/assess the salt tolerance and potential as a crop, but also to give insight into the optimal agronomic conditions for cultivation. In this regard, studying the ecology and ecophysiology of halophytes remains important. Next, the evaluation of the growth performance under field conditions is the imperative next step.

Chapter 1 focuses on different aspects of salinization, saline agriculture, and salt tolerance in general and an overview is given of the research questions which were addressed in the different chapters. The overall aim of this thesis is to contribute to the scientific knowledge of the ecology of (strandline) halophytes, their ecophysiological response to salinity, and their cultivation under field conditions.

Although it is well known that plant species occurring in the salt marsh habitat demonstrate high salt tolerance and potential for saline agriculture, relatively little is known about that of plant species occurring in the strandline habitat. In Chapter 2 it is shown that although salt spray is most important in determining the different vegetation characteristics of the strandline, the influence of soil salinity and incidental seawater flooding is considerable. Strandline plant species are exposed to enhanced levels of salt spray and occasional seawater flooding. The strandline species examined appeared to be moderately salt tolerant for increased root zone salinity and are able to survive short peaks of high salinity.

Crambe maritima, a typical strandline plant species, was exposed to various levels of airborne and soil borne salinity in a greenhouse experiment to assess tolerance to root zone salinity and salt spray (Chapter 3). Here, it is shown that salt spray caused no growth reduction in contrast to the root zone salinity treatments. Root zone salinities up to 20 % seawater salinity did not result in a decrease in relative growth, but a sharp decrease in growth was observed at 40 % seawater salinity which was mainly caused by the reduction in specific leaf area. Other morphological and physiological parameters changed with increasing salinity, but not any of these parameters could be linked with the observed growth reductions. Based on its growth response Crambe maritima can be classified as a salt spray tolerant plant that is sensitive to root zone salinities exceeding 20 % seawater salinity.

Two other species occurring in coastal habitats, namely Diplotaxis tenuifolia (L.) and Cochlearia officinalis (L.) may be assumed to be moderately salt tolerant as well. The growth performance under saline conditions was determined in a greenhouse experiment for D. tenuifolia and for C. officinalis (Chapter 4). The relative growth
rate at ≥ 40 % seawater salinity showed about 20 % reduction for both species, which could be contributed to a reduction in specific leaf area. In comparison with seven other Brassicaceae species, including salt sensitive and highly salt tolerant species, both *D. tenuifolia* and *C. officinalis* showed an intermediate salt tolerance. Both species can be classified as moderately salt tolerant with potential as vegetable crop for saline agriculture.

In Chapter 5 it is described how an experimental saline field site was created on Texel, The Netherlands. Seawater drip irrigation was applied to cultivate halophyte crop species under saline conditions. Soil salinity was monitored during the course of the experiment. The three populations of *Beta vulgaris ssp. maritima*, as well as *Plantago coronopus*, all showed continued growth under field conditions at 40 % seawater salinity. Differences in salt tolerance were found and analyzed between three populations of *Beta vulgaris ssp. maritima*.

By studying the ecology and ecophysiology of strandline halophytes various questions related to exposure to salinity, defining and calculation of salt tolerance and agronomic conditions for cultivation have been considered and analyzed. Based on hydroponic crop cultivation in the greenhouse, growth and ecophysiological parameters have been analyzed and salt tolerance has been assessed for *Crambe maritima*, *Diplotaxis tenuifolia* and *Cochlearia officinalis* which contributed to the understanding of the mechanisms of salt tolerance. In addition, field experiments with varying but controlled soil salinity are needed to test the plants’ suitability as a new saline vegetable crop. The ecological, ecophysiological characteristics of the plant species studied, as well as the practice of cultivation of halophytes under saline field conditions, taste and edibility, as described and analyzed in this thesis contribute to the development of saline agriculture. Further development of sustainable exploitation of saline resources relate to market development, costs and benefits of saline crop products and imply upscaling of outdoor or indoor saline crop cultivation.