A comparison between *Carex arenaria* L. and *Carex ligerica* GAY — sedges from the *Arenariae* group based on leaf characteristics

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Abstract

The purpose of the study was to compare two taxonomically close species of sedges — *Carex arenaria* and *Carex ligerica*. The analysis was based on 6 characters of leaves. The populations studied were grown for the period of at least one year under the same conditions in a greenhouse. The results of statistical analysis indicate a distinctive character of each of the studied populations. Furthermore, the results show a higher interpopulational differentiation among *C. ligerica* populations.

Key words: *Carex arenaria*, *Carex ligerica*, variation, populations

INTRODUCTION

Carex arenaria and *Carex ligerica* — sedges of *Arenariae* group constitute a very interesting object of investigation because of both the geographical location of their natural habitats and their biological characteristics. *C. arenaria*, as a representative of subatlantic plants, is found in Poland in isolated stations as well as in continuous range areas. It grows on sites specific for itself, i.e. grey dunes on the Baltic seacoast (continuous range) and isolated stations (sandy interforest dunes or the borders of pine forests). It reaches its eastern range border in Poland.

C. ligerica, on the other hand, occurs mainly on the territory of western Europe, while in Poland it is found only in isolated stations. Since both species often grow on island-type stations, they are very important objects of investigations from the evolutionary point of view. Genetic drift may have an essential influence on the genetic structure of such populations. Speciation in isolated

populations occurring at the borders of the range might be particularly intense (M a y r 1963).

The genetic structure of populations is obviously affected by the mode of reproduction which is similar for the species in question — generative and vegetative reproduction is observed in both species.

This paper compares these two similar species (U r b a n i a k 1984, 1988a, 1988b, 1990, U r b a n i a k in press) on the basis of anatomical characteristics of leaves.

MATERIAL AND METHODS

Nine populations of *C. arenaria* and seven populations of *C. ligerica* were collected on site (Table 1). *C. arenaria* populations were collected from an areas of continuous range (1, 2, 3, 4 — seaside zone; 7, 8 — Lower Silesia) and from isolated stands — 5, 6, 9. Populations of *C. ligerica* were collected only from isolated stands. The geographical distribution of the investigated populations is given in Fig. 1.

Fig. 1. Geographical distribution of the investigated populations (*Carex arenaria* — full circles, *C. ligerica* — empty circles)

Table 1
List of stations

Population No.		Station	Date of collection of rhizomes	Habitat	No. of plants
<i>Carex arenaria</i>	1	Międzyzdroje	30.11.1977	grey dune	28
	2	Ustka	14.06.1978	grey dune	30
	3	Rąbka	26.06.1978	border of pine forest growing on grey dune	29
	4	Białagóra	15.06.1978	border of pine forest growing on grey dune	30
	5	Lulkowo	01.11.1977	border of pine forest	29
	6	Witnica	25.07.1978	young pine stand	30
	7	Konotop	22.05.1978	border of pine forest	30
	8	Ołobok	08.07.1973	young pine stand	30
	9	Zielonka	08.07.1978	border of pine forest	30
<i>Carex ligerica</i>	10	Kadyny	10.11.1977	border of pine forest	27
	11	Szumilowo	07.08.1976	young pine stand	27
	12	Kopanica	02.08.1977	border of pine forest	27
	13	Złotoria	10.08.1976	interforest dune	27
	14	Toruń-Wrzosy	10.08.1976	border of pine forest	27
	15	Toruń-Wrzosy	10.08.1976	border of pine forest	27
	16	Tychnowy	02.10.1977	border of pine forest	27

All of the plants were placed in a greenhouse and kept under equal conditions in order to eliminate differential influences. Leaves were collected after a year's growth. Each leaf was cut in the middle of its length. Three cross-sections of three leaves from each plant were placed on a slide and then embedded in polyvinyl alcohol.

Characters a, b, c, d, e, f (Fig. 2) were measured by means of a light microscope at a magnification of 40. The measured characters are the same as those presented by Szweykowski and Chwilkowska (1976). In order to detect the interpopulational variation between *C. arenaria* and *C. ligerica* discriminant variable analysis and the dendrite technique were used.

RESULTS AND DISCUSSION

The leaves used to assess variation were taken from plants which had been growing under the same circumstances in a greenhouse for at least a year. Therefore, we may reasonably expect the differences observed in the course of the investigations to have been of a genetic nature.

The same testing procedure was used in the works on interpopulational variation of *Carex arenaria* (Krzakowa et al. 1978, Urbaniak 1984).

Fig. 2. Diagram of a leaf blade section showing the measured characters: a — width of the half-leaf blade, b — maximum width of the leaf, c — angle of the leaf margin, d — angle between both halves of the leaf blade, e — number of air-chambers in the half leaf blade, f — number of vascular bundles in the half blade

The obtained results revealed a distinctly genetic-type variation. The populations from continuous ranges displayed a different genetic structure than the populations from isolated stations. Investigations of the variation of *C. ligetica*, in which the populations were also subject to equalizing cultivation in a greenhouse, revealed strong variation within the species (Urbaniak 1988a, 1988b, 1990).

Phenolic compounds, regarded as genetic markers of differentiation, have previously been used for the comparison of both species (Urbaniak in press) and have demonstrated the different characters of *Carex arenaria* and *Carex ligetica*. The majority of the phenolic compounds, however, were common to both species while only a few of them appeared in either *C. arenaria* or *C. ligetica*. The populations significantly differed in the frequency of occurrence of particular phenolic compounds.

The present paper investigates the anatomical characteristics of leaves in 9 *C. arenaria* and 7 *C. ligetica* populations, giving a basis for a comparison of both species. The resulting picture of variations shows the different characters of *C. arenaria* and *C. ligetica* populations. This is manifested by a dendrite based on Mahalanobis distances — *C. arenaria* and *C. ligetica* populations are grouped on opposite sides of the dendrite (Fig. 3). This differentiation is confirmed by analysis of discriminant variables (Figs. 4 and 5). Moreover higher differentiation with *C. ligetica* populations is observed. Analysis of phenolic compounds lead to similar conclusions. This could probably be explained by the genetic structure of *C. ligetica* populations, it does not exchange genes with other populations which could possibly lead to higher differentiation.

Fig. 3. Dendrite based on shortest taxonomic distances between populations of *C. arenaria* and *C. ligerica* for leaf characters

Fig. 4. Distribution of populations (*C. arenaria* — full circles, *C. ligerica* — empty circles) on a plane of the first (U_1) and the second (U_2) discriminant variables axes for leaves characters

Fig. 5. Three-dimensional space diagram (*C. arenaria* — full circles, *C. ligerica* — empty circles) based on the first three discriminant variables for leaf characters

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Porównanie Carex arenaria L. i Carex ligerica GAY — turzyc z grupy Arenariae na podstawie cech liści

Streszczenie

Celem pracy było porównanie dwóch bliskich sobie taksonomicznie gatunków turzyc — *Carex arenaria* (9 populacji) i *Carex ligerica* (7 populacji). Analizy te zrobiono na podstawie 6 cech liści. Materiał badawczy — populacje obu gatunków przed badaniem hodowano przez co najmniej 1 rok w wyrównanych warunkach w szklarni. Analizy statystyczne wskazały na odrębność badanych gatunków. Ponadto zaznacza się większe zróżnicowanie w obrębie populacji *C. ligerica*.