

EFFECTS OF TEMPERATURE AND MOISTURE ON THE GERMINATION OF TWO ECOTYPES OF *SONCHUS ARVENSIS* L.

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SUMMARY

In the Netherlands two ecotypes of *Sonchus arvensis* L. are found: var. *arvensis* (arable type) on arable land and var. *maritimus* G. F. W. Mey. (coastal type) in coastal dunes. The author's experiments show that these differ in their response to temperature and moisture during germination.

The coastal type germinates faster than the arable type and its germination occurs already at lower temperatures. Furthermore the coastal type germinates at lower moisture tensions.

From these experiments it appears that the coastal type is better adapted to the germination conditions prevailing in the dune habitat. The germination characteristics of the arable type fit in well with its natural distribution pattern.

1. INTRODUCTION

In the Netherlands two ecotypes of *Sonchus arvensis* L. occur: *Sonchus arvensis* L. var. *arvensis* and *Sonchus arvensis* L. var. *maritimus* G. F. W. Mey. Var. *arvensis*, the arable type, is found mainly on arable land, on roadsides, in ruderal habitats, and on newly reclaimed land (e.g. in polders of the former Zuiderzee and Lauwerszee). Var. *maritimus*, the coastal type, occurs chiefly in the outer coastal dunes and besides in places of coastal salt marshes that may be flooded in winter for a short time. Environments as outlined may be found at relatively small distances of each other. Putative hybrids are sometimes found in young polders close by the sea. Both ecotypes have the same chromosome number, viz. $2n = 54$.

This paper treats the question whether differences in germination characteristics as related to temperatures and soil moisture tensions may be regarded as environmental adaptations.

2. MATERIAL AND METHODS

Achenes from randomly chosen plants of both ecotypes were collected in August and September, 1969. The coastal type achenes came from an outer dune area of the West Frisian island of Schiermonnikoog. The achenes of the arable type were collected in a sugar-beet field near Anjum (province of Friesland).

The achenes were air-dried and stored at 4°C; no other pre-treatment was given. Germination tests started at different time intervals.

leaves of two ecotypes of *Sonchus arvensis* L.

left: arable type

right: coastal type

2.1. Temperature effects

In petri dishes 50 achenes were spread on filter paper discs moistened with tap water. The dishes were placed in germination chambers kept at different but constant temperatures and with 12 hours light regime. These tests lasting 14 days were carried out in fivefold. Germinated achenes were counted and removed.

In another experiment achenes were first exposed to a temperature of 10° C for 6 days and subsequently to 25°C for different lengths of time whereupon they were again exposed to 10°C. On the 13th day the exposure to 25°C for the same times was repeated. This test, carried out in threefold, was done for the purpose of finding out if germination is affected by the cumulative action of temperatures. The experiment was terminated after 19 days. All the seeds received 12 hours of light per day.

2.2. Moisture effects

Soil moisture contents corresponding with a wide range of matric potentials were determined on sieve fractions of 0,105 to 0,150 mm, and 0,150 to 0,210 mm. Sand box, pressure membrane, and vapour equilibration methods were employed (PEERLKAMP & BOEKEL 1960; STAKMAN & VAN DER HARST 1969). The pF curve of the top layer of 2 to 7 cm of outer coastal sand of Schiermonnikoog

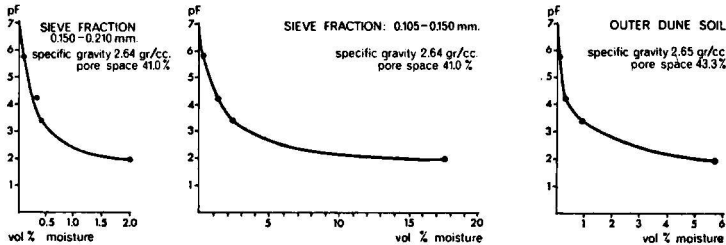


Fig. 1 MOISTURE RETENTION CURVES OF THREE SOILTYPES

was also established. Specific gravity determinations were made with the pycnometric method (BOEKEL 1961). Results are given in *fig. 1*.

Desired soil moisture conditions were established in the following manner. Glass pots were marked at 100 ml. With reference to pF curves, required quantities of soil and water were weighed and mixed thoroughly. The moistened soil was then transferred to a glass pot and pressed down to the 100 ml mark.

In each glass pot 50 pappus-free achenes of both ecotypes were separately spread on the soil surface and pressed down lightly for close contact. Sealed with lids, all pots were placed in a germination chamber kept at a constant temperature of 25°C and with a 12 hours light regime. A constant temperature was chosen in order to minimize irregular disturbances in created soil moisture conditions through evaporation and subsequent condensation. All treatments were repeated four times. Germinated achenes were counted and removed.

3. RESULTS AND DISCUSSION

Fig. 2 shows temperature effects on the germination of achenes of both ecotypes. Over the full range investigated the coastal type germinates faster than the arable type; most pronouncedly at 20°C. Up to 17°C only the coastal type germinated. At the range of 25° to 30°C germination rates of both ecotypes were optimal.

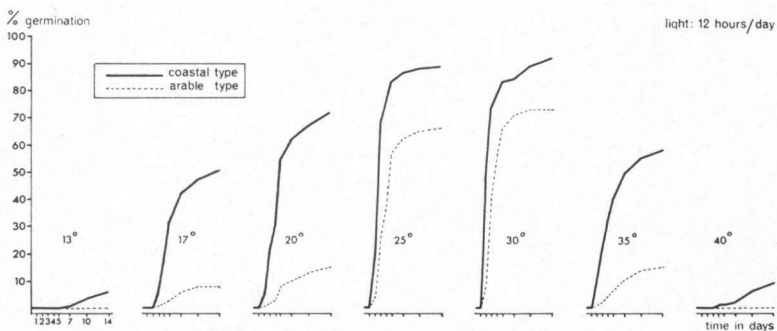


Fig. 2 INFLUENCE OF DIFFERENT CONSTANT TEMPERATURES ON THE GERMINATION OF TWO ECOTYPES OF SONCHUS ARVENSIS L.

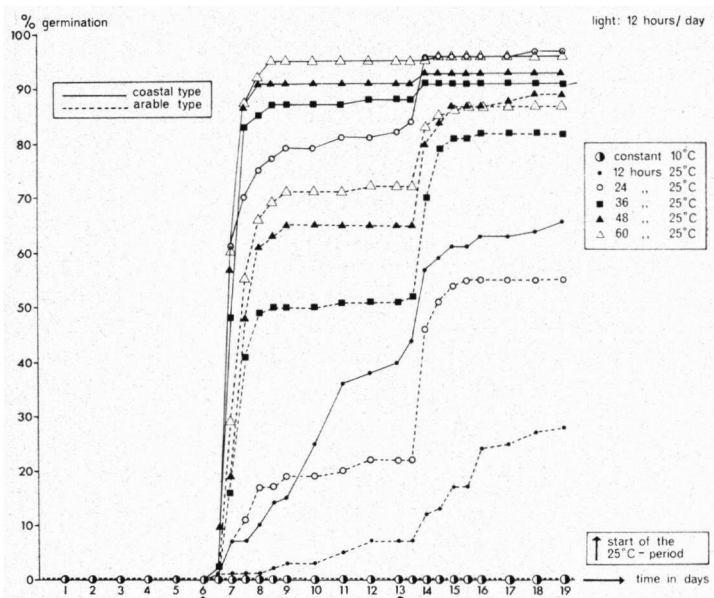


Fig.3 INFLUENCE OF DIFFERENT TEMPERATURE REGIMES ON THE GERMINATION OF TWO ECOTYPES OF SONCHUS ARVENSIS L.

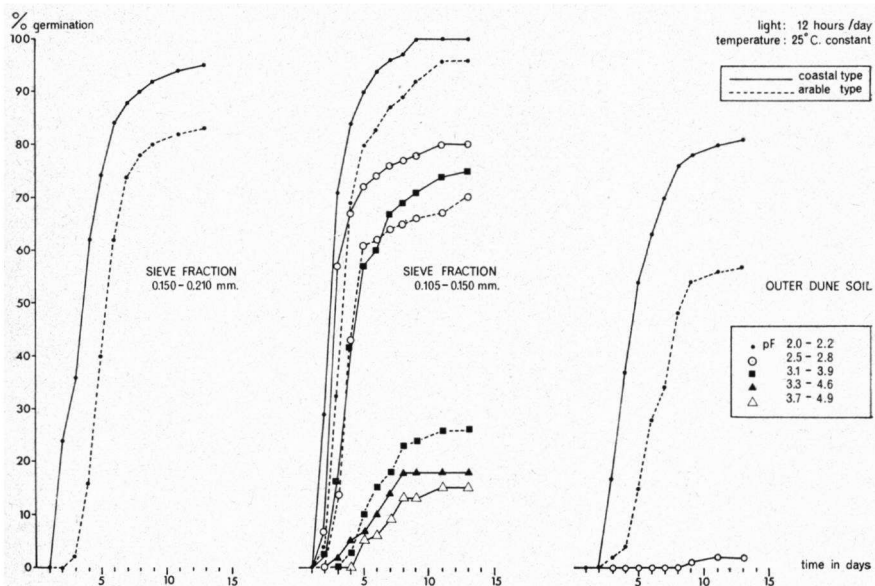


Fig. 4 INFLUENCE OF DIFFERENT MOISTURE TENSIONS ON THE GERMINATION OF TWO ECOTYPES OF SONCHUS ARVENSIS L.

STEVENS (1924) found that achenes of the arable type rarely germinate at 20°C. If exposed to 32°C for a few hours daily they germinate freely in 4 to 7 days. LAUER (1953) reported that the arable type requires relatively high temperatures for full germination.

Achenes of both ecotypes treated at 25°C for different lengths of time germinated as described before (fig. 3). The coastal type germinated quicker and required shorter periods of 25°C to reach a specified germination percentage than the arable type. It is striking that after a period of 12 hours at 25°C the germination does not stop. This particularly holds for the coastal type.

Effects of soil moisture tensions are comparable with temperature effects (fig. 4). The overall result is that the coastal type germinated faster at all moisture tensions investigated. At low moisture contents only the coastal type germinated. Though identical moisture tensions were created in three types of soil, germination differed.

Apparently, available moisture is not the only factor affecting germination. Specific effects of other factors to be considered include osmotic potential of the soil solution, moisture diffusivity of the soil, seed-soil contact area, and water diffusivity of the seed (HADAS 1970).

Results suggest that germination characteristics of the coastal type are relatively better adapted to the dune habitat than those of the arable type. Germination field tests conducted in the outer coastal dune area of Schiermonnikoog indicated the same (table 1).

Germination characteristics investigated do not account fully for the ecological distribution. It would appear that such is governed by a number of mutually interacting factors. Effects of inherent growth pattern, mineral nutrition, and mechanical disturbance are being investigated (PEGTEL in press).

Table 1. Number of seedlings of both ecotypes of *Sonchus arvensis* L. at different dates. Sown on 5/6/1969: 500 achenes of both ecotypes in bottomless plastic boxes, 1 cm deep.

Date	26/6	16/7	6/8	28/8	17/9/69
Coastal type	70	95	95	95	83
Arable type	2	5	5	5	3

None of the arable type seedlings developed into fully grown plants; of the coastal type seedlings only a fraction did.

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