Cold hardiness in Arctic plants as a requirement of colonization of the post-glacial Arctic

Extended Abstract

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DOI: 10.5817/CPR2013-1-5

Introduction

Over their evolutionary history, organisms have been adapting to most diverse environments. Plants, from the green algae to the most advanced angiosperms have diversified in their forms and survival strategies to fill all reachable niches over a great range of conditions. Those, living in the most contrasting habitats are called extremophiles („lovers" of extremes: hot-cold, wet-dry, alkaline-acid, etc.), although some of them may not necessarily "love" but rather only tolerate their habitat conditions. The cold-hardened arctic and alpine species, the cryophytes, belong to this category. They evolved in regions subjected to orogeny by being slowly carried up with the rising mountains to high altitudes. In some cases, they have been rafted to the polar regions by the Northward migration of the continents. During the Interglacial and after the last Ice age, the clean slate of the deglaciated North American continental landmass acted as a large sheet of chromatographic paper along which the plant species travelled as far north as they were able to tolerate the increasingly hostile conditions.

Cold hardiness

Some tundra species are more cold-hardened than others, although additional limiting factors are also involved. According to the degree of cold and stress tolerance, various species reached and established at different geographical positions and now form separate or overlapping ranges of their spatial distribution. All tundra species would prefer more favourable environment than the one they occupy most. Even these cold hardened plants are under stress. However, they recover fast, if the conditions change for the better. At present, vegetation complexes of similar vigour, competitive strength and stress tolerance form distinct vegetation zones in the N. American tundra biome. The vegetation of these zones has been in a dynamic equilibrium with the extant climate. However, the zones have shifted in the past and are bound to shift again, as the climate ameliorates. The cold-hardened algae and bryophytes play a crucial role in the colonization of freshly deglaciated terrain by fixing nitrogen and building the first biomass for the higher plants establishment.

Received November 30, 2012, *accepted* January 22, 2013
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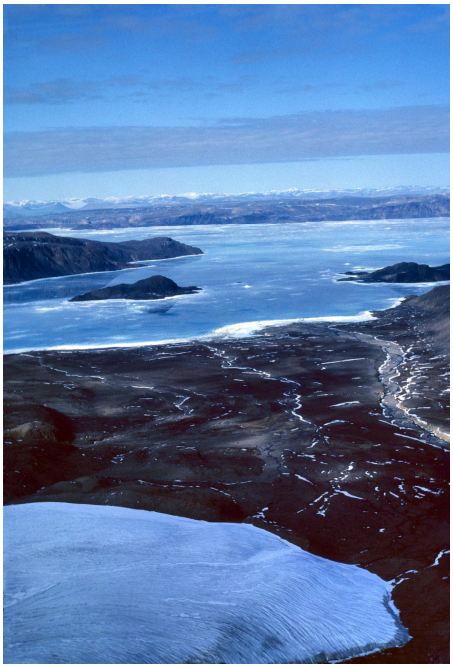

Fig. 1. Wiev to Alexandra Fiord, 79°N - Central-East part of Ellesmere Island, Canadian Arctic Archipelago. Here the University of Toronto research station has been located.

Fig. 2. and **Fig. 3.** Green igloo experiment at the beginning of cultivation and close of farvest time.

Summary of field experiments

The horticultural experiment with southern cultivars at Alexandra Fiord 790N confirmed that even warm-climate vegetables grow well in an naturally ameliorated space bubbles, "igloos" (sun-heated greenhouses) in a generally hostile climate. Similarly, the native tundra plants, transplanted into the same "igloos", grew much taller and produced several times more seeds and bulblets than plants in the nearby tundra.