Effect of Different Sugars on Flowering of *Chenopodium rubrum* L.
in Dependence on the Conditions of Germination and Initial Growth

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Abstract. Flowering of *Chenopodium rubrum* seedlings fed different sugars at a concentration of 0.6 and 0.4 M, resp. during a single inductive cycle was stimulated or inhibited in dependence on the conditions of germination and initial growth. Plants allowed to germinate at alternating temperatures of 28 °C and 5 °C showed a slower initial growth and their development was stimulated by some sugars as compared to controls induced in the absence of sugars. Plants germinated at alternating temperatures of 32 °C and 5 °C exhibited a rapid initial growth and flowering was inhibited after induction in the presence of sugars. On the other hand, development proceeded more rapidly in control plants induced in the absence of sugars after germination at the higher temperature than after germination at the lower one. The differences between the two variants quoted above could be observed also after induction by two 16 h dark cycles. Glucose and sucrose were most effective in stimulating flowering under appropriate conditions of germination. Fructose was less effective and the action of maltose was very weak. Xylose, ribose and galactose were innocuous, while arabinose, glucoso-6-phosphate and mannitol were toxic to the plants. The sugars inhibited root growth in all cases and led to an increase in starch accumulation in the underground and overground plant organs. At a concentration of 0.6 M they mostly inhibited the length of the cotyledons and, especially, of the first leaf; at a concentration of 0.4 M growth of the overground organs was stimulated. The results are discussed with respect to the possible changes in photoperiodic sensitivity brought about by the rate of initial growth.

In a previous communication (Teltscherová et al. 1974) it was shown that in *Chenopodium rubrum* feeding glucose during an inductive period of darkness not only enhances the amplitude of the flowering response and prevents rapid damping out of the endogenous rhythm of flowering but also stimulates flowering by enabling a certain percentage of plants to attain the reproductive state after a single photoperiodic cycle. The aim of further experiments was therefore to ascertain whether other sugars exert a similar effect and to examine the conditions necessary for the manifestation of this stimulation.

Material and Methods

The plants were germinated at alternating temperature and light conditions. In one experimental variant the seeds received 14 h light at 28 °C,
10 h darkness at 5 °C and 16 h light at 28 °C. (This variant will be further referred to as germinated at a lower range of temperatures.) Seeds of the second variant were treated with a temperature of 32 °C during the light phase of germination, the other conditions being the same as described above (germination at a higher range of temperatures). After germination the seedlings were transferred to small vessels containing half strength Knop's solution and were grown in continuous fluorescent light (about 7000 lx) and at a constant temperature (20 ± 1 °C) for 3½ days prior to floral induction. Thereafter, the plants were subjected to a single inductive dark period of 16 h. Different sugars at a concentration of 0.6 and 0.4 M, resp. were added to the nutrient solution during darkness in the experimental varieties. At the termination of induction the plants were returned to pure Knop's solution and grown in continuous light under constant conditions up to the termination of the experiment. For comparison the plants were given two inductive cycles of 16 h darkness and 8 h light in some experiments. Sugars were added to the nutrient solution during both dark periods in this case.

The following sugars were examined: glucose, fructose, galactose, sucrose, maltose, xylose, ribose, arabinose and glucoso-6-phosphate. For comparison mannitol was also applied.

After the termination of the experiments the morphological stage attained by the shoot apex was determined. Also the following indicators of vegetative growth were estimated: length of roots, hypocotyls, cotyledons and the first leaf pairs and total number of leaves. During germination, at the time of transfer to Knop's solution and immediately following induction, the content of starch was determined in the single organs using the histochemical test with IIK.

Results

The rate of germination and of initial growth could be regulated in the experimental plants by applying different ranges of temperature during germination. During the first light period of germination only imbibition of the seeds occurred. The seed coats ruptured about 4 h after transfer to darkness and low temperature in seeds kept at 32 °C during the preceding light period and about 3 h later in seeds kept at 28 °C. The radicle started to emerge from the seed coat sooner and grew more rapidly in seeds kept at the higher temperature and a positive reaction to starch appeared in the root tips 3 h earlier than in the variant kept at the lower temperature. The radicles completely emerged from the seed coats about 4 h after transfer of the seeds to the second period of light at 32 °C and starch began to accumulate along the root vessels. After further 3—4 h the upper cotyledon became partly visible. At this time an intensive reaction to starch was obtained in the hypocotyl and starch accumulation started in the cotyledons mainly at the inner side adjoining the endosperm. All these changes were delayed by several hours at a temperature of 28 °C. At the time of transfer of the seedlings to Knop's solution the roots of plants germinated at 32 °C attained a length of 5—6 mm. The cotyledons had completely emerged from the seed coats which covered their tips only and frequently dropped away on handling the plants. The reaction to starch was intensive in the roots, hypocotyls and cotyledons. The roots of seedlings germinated at 28 °C were